MAY, 1941.

GENERAL PHYSICS.

ATOMIC AND MOLECULAR STRUCTURE.

∗682. Efficiency of electrolytic separation of Li isotopes. H. L. Johnston and C. A. Hutchison. *J. Chem. Phys.*, **8**, *pp.* 869–877, *Nov.*, 1940.—The electrolytic separation coefficient, α, was determined for the Li isotope separation in the electrolysis of LiCl solutions at a Hg cathode. Within the limits of error its value was independent of temperature, of the fraction electrolysed and of the amount of back reaction at the cathode. The factor was the same for LiCl dissolved in absolute ethyl alcohol as for aqueous LiCl. Isotopic analyses were made by a densimetric method of relative atom. wt. determination. Crystalline materials with densities reproducible to the fifth decimal place were prepared. The observed separation is markedly larger than would be given by the exchange equilibrium. It is therefore certain that a kinetic mechanism is operative, although partial approach to equilibrium may enter as a secondary process. The data are consistent with Bell's quantum-mechanical explanation ($\alpha = 1{\cdot}12$) or with a diffusion layer mechanism ($\alpha = 1{\cdot}08$) if partial approach to equilibrium is assumed as a secondary step. Authors.

683. Theory of some van der Waals molecules. R. Heller. *J. Chem. Phys.*, **9**, *pp.* 154–163, *Feb.*, 1941.—The vibrational wave number and energy of dissociation of the molecules HgHe, HgNe, HgA, HgKr, HgXe, Hg_2, $(O_2)_2$ and $(NO)_2$ in the normal state are calculated. Satisfactory agreement is obtained with experimental data except in the case of $(NO)_2$. The latter structure is believed to owe its binding partly to first-order attractive forces. Author.

684. The van der Waals force between a proton and a H atom. C. A. Coulson. *Proc. Roy. Soc. Edinb.*, **61**, 1, *pp.* 20–25, 1941.—The potential of the van der Waals force is obtained in terms of an expansion in falling powers of the inter-atomic distance. This starts in the case of a proton and a H atom as a term in R^{-4}, and has been evaluated as far as the term in R^{-10}. All terms are negative. R. P.

685. Further development of the fabric theory of protein structure. D. Wrinch. *Phil. Mag.*, **31**, *pp.* 177–198, *March*, 1941.—It is emphasized that the closed fabric cage structure explains the paradox that globular proteins, though megamolecules, have definite physical and chemical properties and highly specific individualities. The structures proposed for consideration comprise closed cage structures resulting from the original cyclo fabric, the enol fabric, and hydrogen-bond fabrics, and have skeletal residue numbers of the forms $24n^2$, $48n^2$, $72n^2$. [See Abstr. 2315 (1937).] Author.

686. Vibrations and molecular structure of urea and guanidonium. L. Kellner. *Proc. Roy. Soc. A*, **177**, *pp.* 456–475, *March* 18, 1941.—The vibrations of urea and guanidonium have been calculated for a field containing valence and angle forces. The assumption is made that urea has the symmetry C_{2v} and guanidonium C_{3h}. It is shown that it is possible to assign every observed frequency of these two substances to definite modes of vibration under these assumptions. The force constants have been evaluated and have been found to be $f_{C-O} = 7{\cdot}1 \times 10^5$ dynes/cm. for guanidonium, and $f_{C-O} = 6{\cdot}6 \times 10^5$ dynes/cm. and $f_{C-O} = 9{\cdot}7 \times 10^5$ dynes/cm. for urea. These values are compatible with the hypothesis that quantum-mechanical resonance occurs in both molecules, with the result that the C—N bond in urea has approximately 28% double-bond character and the C = O linkage a corresponding single-bond character. The guanidonium ion shows complete resonance; each C—N bond has $\frac{1}{3}$ double-bond character. Curves have been drawn to illustrate the relation between the valence force constants and the bond character. Author.

COLLOIDS.

∗687. Studies of mechanical properties of substances of high mol. wt. I. Photo-elastic method for study of transverse vibrations in gels. J. D. Ferry. *Rev. Sci. Instrum.*, **12**, *pp.* 79–82, *Feb.*, 1941.—The wavelengths of transverse vibrations in gels are measured at various frequencies by observing the strain double refraction stroboscopically. Use of a Babinet compensator inclined at a small angle to the plane of polarization of incident light detects very small amounts of double refraction. From the velocity of propagation of the vibrations the modulus of rigidity is calculated; values ranging from 300 to 13 000 dynes/cm². have been determined. AUTHOR.

688. Features and implications of the near infra-red absorption spectra of various proteins: gelatin, silk fibroin and zinc insulinate. J. D. BATH AND J. W. ELLIS. *J. Phys. Chem.*, **45,** *pp.* 204–209, *Feb.*, 1941.—Studies of oriented silk fibroin fibres with plane polarized infra-red light indicate that the majority of the carbonyl bonds, C = O, are oriented perpendicular to the fibre axis. This observation confirms the previous findings from X-ray analysis, which show that the long, chain-like silk fibroin molecules lie parallel to the fibre axis. Infra-red absorption studies of zinc insulinate cystals indicate the absence of OH and the presence of NH bands. This observation does not support the suggestion of numerous peptide hydroxyl groups, as given in the cyclol hypothesis of the structure of the insulin molecule. AUTHORS.

689. Comparison of the effects of neutron and γ-ray ionization on the electrophoretic mobility of colloidal graphite particles. L. H. GRAY, J. READ AND H. LIEBMANN. *Brit. J. Radiol.*, **14,** *pp.* 102–106, *March*, 1941.—The effects of neutron and γ-ray ionization on the electrophoretic mobility of colloidal graphite particles are qualitatively similar, but the amount of γ-ray ionization required to produce a given change in electrophoretic mobility is considerably greater than that of neutron ionization, the difference amounting to 8 times in the case of a certain sample of graphite. The results are discussed. A. J. M.

690. Time and temperature effects in the formation of colloidal dispersions. P. G. NUTTING. *J. Wash. Acad. Sci.*, **31,** *pp.* 41–45, *Feb.* 15, 1941. —The behaviour of montmorillonite clays in acids of various concentrations and with various ratios of acid to clay have been investigated. Solutions in dilute HCl at 28° and 90°C. may contain more than twice as much SiO_2 as a saturated solution of SiO_2 in H_2O. At 90° equilibrium is reached in about 4 days; at 28° it is not reached after 128 days. The bearing of these results on the formation of clay colloids in rock cavities and soils is discussed. A. J. M.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

691. Bethe-Kirkwood's partition function for a binary solid solution. T. S. CHANG. *J. Chem. Phys.*, **9,** *pp.* 169–174, *Feb.*, 1941.—A symmetrical method of finding the Thiele semi-invariants λ_n in the partition function for a binary solid solution is described. In addition to the first 4 λ's already known, λ_5 and λ_6 are calculated. [See Abstr. 4433 (1939).] AUTHOR.

692. Second-neighbour interactions and the critical behaviour of binary solid solutions. T. S. CHANG. *J. Chem. Phys.*, **9,** *pp.* 174–176, *Feb.*, 1941.—The Thiele semi-invariants γ_1, γ_2 and γ_3 of a binary solid solution are calculated on the assumption that there are second-neighbour interactions as well as first-neighbour interactions. The results give a decrease of the critical temperature T_c at which the superlattice sets in, an increase of the local order σ at T_c, and an increase of the discontinuity of the specific heat. They are thus in general agreement with the results obtained by applying Bethe's methods to the same problem. AUTHOR.

693. Simplified correction factor for equi-inclination Weissenberg patterns. B. E. WARREN AND I. FANKUCHEN. *Rev. Sci. Instrum.*, **12,** *pp.* 90–93, *Feb.*, 1941.—The correction for the Lorentz polarization rotation factor for equi-inclination Weissenberg patterns is given in a simple form in terms of the Lorentz polarization factor for the corresponding equator spot. AUTHORS.

694. Optical crystallographic studies with the polarizing microscope. III. Measurement of several types of selective dispersion in organic compounds. W. M. D. BRYANT. *J. Amer. Chem. Soc.*, **63,** *pp.* 511–516, *Feb.*, 1941.—Five crystalline organic compounds exhibiting measurable crossed axial plane, inclined, horizontal and crossed dispersion, have been characterized optically. The optic axial angles (2*E* or 2Ha) of these compounds have been measured for different wavelengths. Refractive indices, optical character, optical orientation and other useful properties, have also been measured. An earlier technique for measuring optic axial angles has been placed on a photographic basis [Abstr. 56 (1939)]. Identification is facilitated by direct comparison of the negatives. Photographic measurements of the optic axial angles of *n*-butyl carbamate and 2,2′-dipyridyl for a wavelength in the near ultra-violet (3 650 Å) have been made without the need of special optics. AUTHOR.

695. Properties of Rochelle salt. IV. H. MUELLER. *Phys. Rev.*, **58,** *pp.* 805–811, *Nov.* 1, 1940.—A new class of effects in crystals, called morphic effects, arise when elastic strains alter the symmetry of the structure. These effects necessitate the introduction of new coefficients, proportional to the acting strains, into the matrix of the coefficients which characterize the linear effects. The new coefficients give rise to a series of new quadratic effects in crystal physics. Morphic effects play a rôle in the photo-elasticity of cubic crystals and are especially large in the crystals of Rochelle salt, where they are responsible for Kerr effects and for a new type of irreversible piezo-electric effect. This new effect creates irreversible normal strains when the crystal is polarized in the *a* direction, and spontaneous contractions occur when the crystal is cooled to below the Curie point. The spontaneous normal strains are responsible for the anomalous thermal expansion of Rochelle salt and for a series of other anomalies. It is suggested that these strains may also be the reason for the existence of the lower Curie point. [See Abstr. 3228 (1940).] AUTHOR.

See also Abstract 822.

DIFFUSION AND OSMOSIS.

696. Differential diffusion constant of $CaCl_2$ in aqueous solution. E. A. HOLLINGSHEAD AND A. R. GORDON. *J. Chem. Phys.*, **9,** *pp.* 152–153, *Feb.*, 1941.—The constant has been measured for concentrations ranging from 0·0025 to 0·5 mole/l. and for temperatures from 15° to 35°C. The relation connecting the diffusion constant at a finite concentration with that at infinite dilution, which holds for moderate concentrations for several 1 − 1 electrolytes, is valid for this salt only to 0·01 mole/l.; the corresponding value of k_0 is about 1·5% less than that computed from the ionic mobilities by the Nernst relation. The activation energy of diffusion for a given concentration decreases with rising temperature, as is customary; for a given temperature, however, it decreases with increasing concentration in dilute solutions and finally becomes independent of concentration. AUTHORS.

697. Diffusion of water into normal butyl alcohol at 30°C. M. RANDALL, B. LONGTIN AND H. WEBER. *J. Phys. Chem.*, **45,** *pp.* 343–351, *Feb.*, 1941.—The differential diffusion constant of water diffusing into *n*-butyl alcohol was measured continuously over the range of concentration of the *n*-butyl alcohol-rich phase. The results given depend on a single experiment. The agreement with the predictions of the author's equation is better than with the predictions of the simple Fick's law, and it is concluded that the driving force in diffusion is the free-energy gradient rather than the concentration gradient. AUTHORS.

698. Measurement of self-diffusion in Zn. F. R. BANKS. *Phys. Rev.*, **59,** *pp.* 376–381, *Feb.* 15, 1941.—Long-lived radioactive Zn^{65} was used as an indicator. Measurements were made along the *C* axis of Zn single crystals at 6 different temperatures, enabling a determination of the activation energy to be carried out. AUTHOR.

699. Determination of molecular and ionic weights of dissolved substances by dialysis and free diffusion. G. JANDER AND H. SPANDAU. *Z. phys. Chem. A*, **187,** *pp.* 13–26, *July*, 1940. *In German.*—The authors investigate the conditions under which the comparatively slow method of diffusion tests may be replaced by the quicker and more convenient method of dialysis for determining mol. and ionic wts. of dissolved substances. Much depends on the diameter of the pores of the material used for the diaphragm. An average dia. of 500 Å has proved adequate for the purpose. The dialysis coefficients as measured with this diaphragm are proportional to the diffusion coefficients for particle weights up to about 5000. The product of the dialytic coefficient and viscosity is constant, independent of the type and concentration of the electrolyte. Some practical hints are given for the design of the filter. R. N.

ELASTICITY AND PLASTICITY.

700. Behaviour of Young's modulus of β-brass single crystals at low temperature. J. S. RINEHART. *Phys. Rev.*, **59,** *pp.* 308–309, *Feb.* 1, 1941.—Young's modulus for 7 single crystals of β-brass has been measured at the temperatures of liquid oxygen and of dry ice and acetone. The reciprocals of the moduli in different directions in the crystal lattice were found to vary linearly with temperature down to − 183°C. and the anomalous behaviour of these quantities, observed at room temperature, persisted. AUTHOR.

701. Kinetics of order-disorder transformation in Cu_3Au. S. SIEGEL. *J. Chem. Phys.* **8,** *pp.* 860–866, *Nov.*, 1940.—Using the elastic modulus S_{11} as an indicator, the rate of the transformation was investigated in the region near the critical temperature. The variation of S_{11} with time, at constant temperature, of a [100] single crystal of the alloy was measured, and all the data for the transformation from disorder to order can be represented in one curve by plotting the fraction of untransformed material against the reduced time t/τ. The relaxation time decreases rapidly with increasing amount of cooling below the critical temperature, and, combined with the data of Sykes and Evans on the resistivity/time curves, points to a min. about 20 deg. C. below the critical temperature. The observed data are discussed in terms of a mechanism of nucleation and growth for the transformation. AUTHOR.

702. Some general observations on vibration. J. CALDERWOOD. *Trans. N.-E. Cst Instn Engrs Shipb.*, **57,** [14 *pp.*], 1940–1941.—With illustrations drawn from ship structures, vibrations are classified as (1) those capable of reasonable mathematical interpretation with few assumptions, e.g. torsional vibration of engines and shafting, (2) those

in which empirical constants must be introduced in large measure to obtain tolerably accurate results, e.g. hull vibrations. The common statement that a periodic force applied at a node cannot cause vibration is condemned; vibrations set up elsewhere may not be critical as generally understood but may yet have considerable amplitudes. Engine balance, hull vibration due to lack of rigidity in engine frame or impetus of propeller blades, oil engine vibration from air inlet (organ pipe effect) and vibration of steam in main (analogous to water hammer) are noted; likewise gear drive and the propeller and its shaft receive attention. Elimination by means of frictional or dynamic dampers is considered; in some cases propellers act as absorbers at certain speeds, with consequent loss of efficiency.
G. F. F.

See also Abstract 778.

HYDRODYNAMICS AND AERODYNAMICS.

703. Wind tunnel with open working section. N. Simmons. *Phil. Mag.*, **31**, *pp.* 89–102, *Feb.*, 1941.—The problem of a weak vortex in a 2-dimensional jet issuing from a channel has been discussed previously, and in the present article this investigation is extended to deal with the case where the stream, after having left the channel and met the vortex, passes into a collecting channel of similar form. E. O. T.

704. Hydraulic problem involving discharge into tidal water. I and II. A. G. Walker and J. R. Daymond. *Phil. Mag.*, **28**, *pp.* 520–531, *Nov.*, 1939, *and* **31**, *pp.* 222–230, *March*, 1941.—The problem is that of a tank receiving water at a constant rate while at the same time discharging through a pipe into tidal water, assumed to follow a sine curve. The outflow is supposed to be closed by a valve, to prevent back-flow, when the tide reaches the level in the tank. The authors show that the differential equation defining the height in the tank as a function of time has one periodic solution which is approached by every other solution as $t \to \infty$. This periodic curve is discussed in detail, and it is also shown that a close approximation to a sine curve can be constructed from straight lines and parabolae. In the second paper the effects upon the level in the tank of (1) an isolated surge which abruptly raises that level, and of (2) surges which occur periodically, are discussed mathematically.
J. S. G. T.

705. Turbulent liquid motion outside a circular boundary. II. M. Ray. *Phil. Mag.*, **31**, *pp.* *pp.* 144–155, *Feb.*, 1941.—A previous paper [Abstr. 3531 (1939)] discussed turbulent motion of an otherwise uniform stream in the neighbourhood of a circular boundary and gave a result obtained by successive approximations which was restricted to regions very near the boundary. The present paper gives a more complete solution of the problem. E. O. T.

***706. Rapid method for calibration of flowmeters.** H. J. Meuron. *Industr. Engng Chem.* (*Analytical Edition*), **13**, *p.* 114, *Feb.* 15, 1941.

LENGTH, AREA AND VOLUME.

707. Method for measuring the internal area of section of a glass tube. D. J. Behrens. *Phil. Mag.*, **31**, *pp.* 199–203, *March*, 1941.—The external and apparent internal radii at the section are determined from 3 microscope readings and the determination repeated at intervals of 30° round the section. The author gives the theory, which is applicable whether the external and internal sections are concentric or not, so long as the external section is circular and the internal section is everywhere concave. J. S. G. T.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

708. Phase series. E. J. Hellund. *Phys. Rev.*, **59**, *pp.* 395–399, *Feb.* 15, 1941.—An expansion theorem is developed for the calculation of the parameters occurring in the scattering cross-sections. The series converges exponentially and is expressible in terms of known functions, provided the interactions are expressed as a power series in r and $1/r$. Author.

709. Formulae for the *E*-function. T. M. MacRobert. *Phil. Mag.*, **31**, *pp.* 254–260, *March*, 1941.

710. Statistical analysis of size distribution of particulate materials, with special reference to bimodal and frequency distributions. Correlation of quartile with statistical values. P. S. Roller. *J. Phys. Chem.*, **45**, *pp.* 241–281, *Feb.*, 1941.—A size-distribution function satisfying theoretical boundary conditions and experimental-size data has been further developed [see Abstr. 2953 (1937)] to apply to new classes of materials, including mine-run ores, sand, atmospheric dusts and photographic emulsions. The new features considered are the bimodal character of coarse size distributions and the representation of data on a number/frequency basis (as well as on a cumulative-weight/percent basis). Determination of the 2 parameters of a distribution, or 2 pairs of parameters in the case of a bimodal distribution, leads to evaluation of statistical constants which properly define a material as to size; these constants are surface-area/g., coefficient of uniformity, coefficient of regression and number of particles/g. The physical significance of the constants is discussed and illustrated by examples. A comparison is made of the statistical constants and the corresponding quartile values leading to the deduction that the quartile constants may be used to represent the statistical values. AUTHOR.

711. Abbreviation of the method of least squares. G. J. COX AND M. C. MATUSCHAK. *J. Phys. Chem.*, **45,** *pp.* 362–369, *Feb.*, 1941.

712. Period-hunting in practice. G. T. WALKER. *Quart. J. Roy. Met. Soc.*, **67,** *pp.* 15–18, *Jan.*, 1941. —Three chief indications of periods obtained from the experience of actual calculations are illustrated. The effect of damping in increasing the amplitude of oscillations is shown. The failure of Fourier analysis to indicate the existence of damped oscillations started at irregular intervals is illustrated with regard to magnetic disturbances. A method of reducing the necessary labour by working with small numbers is given, and the errors due to sampling and to approximation in the Fourier analysis by the use of cosine and sine multipliers are explained. R. S. R.

713. Statigraph graph-drawing machine. *Engineering*, **151,** *pp.* 226–228, *March* 21, 1941.—A new machine devised to draw curves connecting 2 variables. A stylus is operated by 2 motions at rt. angles, which are controlled by handwheels set by the operator to correspond to ordinate and abscissa. Continuous curves may be drawn and the scales may be in any units following a linear, logarithmic or any other law. Curves are made on plain (unsquared) paper or on tracing cloth for printing. Higher accuracy than hand drawing is claimed. E. H. W. B.

MECHANICS, CLASSICAL.

714. Statistical mechanics of 1-dimensional substances. II. T. NAGAMIYA. *Proc. Phys.-Math. Soc., Japan*, **22,** *pp.* 1034–1047, *Dec.*, 1940.— The members of the 1-dimensional assembly interact with constant attractive forces that are effective between immediate neighbours only. The partition function is calculated in detail and the equation of state deduced. A gaseous and a liquid state can be defined, but the transition from one to the other occurs continuously, i.e. condensation does not occur. It is deduced that 1-dimensional assemblies are of special character and do not show 3 phases. Classical statistical mechanics are used exclusively. [See Abstr. 38 (1941).] G. C. McV.

MECHANICS, QUANTUM.

715. Hamilton's principal function in quantum mechanics. E. T. WHITTAKER. *Proc. Roy. Soc. Edinb.*, **61,** 1, *pp.* 1–19, 1941.—The method of formulating the equations of motion by means of the Principal Function can be generalized to quantum mechanics, and one can construct an operator function which has all the properties of Hamilton's Principal Function except that it cannot be expressed as the time integral of the Lagrangean. From this a classical function can be obtained which satisfies Schrödinger's equation. These results are used to derive some mathematical relations involving Hermite and Laguerre polynominals. R. P.

716. Reciprocity. V. Reciprocal spinor functions. K. FUCHS. *Proc. Roy. Soc. Edinb.*, **61,** 1, *pp.* 26–36, 1941.—The notion of Fourier coefficients is applied to spinor wave functions. This involves also generalizing the definition of the invariant scalar product and, with this, the method of reciprocity can be carried through, as in the scalar case. [See Abstr. 2030 (1940).] R. P.

717. Self-consistent field calculations for Ge^{++} and Ge. W. HARTREE, D. R. HARTREE AND M. F. MANNING. *Phys. Rev.*, **59,** *pp.* 299–307, *Feb.* 1, 1941.—Results of the calculations are reported and the wave functions and effective nuclear charges are tabulated. The wave functions inside the 3*d* are assumed the same for the 2 stages of ionization. The calculations are carried to a consistency of 0·02 electronic unit in the *Z*'s. [See Abstr. 3894 (1939).] AUTHORS.

PRESSURE.

***718. Vacuum-tight sliding seal.** R. R. WILSON. *Rev. Sci. Instrum.*, **12,** *pp.* 91–93, *Feb.*, 1941.— The operation and construction of a vacuum-tight sliding seal, by means of which unlimited translational and rotational motion in vacuum can be obtained, is described. The seal is made by an appropriately distorted rubber gasket, and a table has been prepared which gives the dimensions of the gaskets to be used for various sizes of sliding rods. AUTHOR.

***719. Pressure regulator for micro-determination of carbon and hydrogen.** J. E. VANCE. *Industr. Engng Chem.* (*Analytical Edition*), **13,** *p.* 132, *Feb.* 15, 1941.

SOLUTION.

720. Liquid ammonia as a solvent. IX. Activity coefficient of KIO_3 at 25°C. V. J. ANHORN AND H. HUNT. *J. Phys. Chem.*, **45,** *pp.* 351–362, *Feb.*, 1941.—[See Abstr. 2163 (1939).] The activity product of KIO_3 at infinite dilution was determined by using the data obtained from a series of measurements of this electrolyte in the presence of an additional salt. Deviations from the limiting Debye-Hückel theory were noted. The low dielectric constant of liquid has been used to explain this departure from the theoretical value. AUTHORS.

721. Solubility studies. II. Activity product and standard electrode potential of $AgIO_3$ from 10° to 35°C. N. C. C. LI AND YING-TU LO. *J. Amer. Chem. Soc.*, **63,** *pp.* 394–399, *Feb.*, 1941.—The solubility of $AgIO_3$ in HNO_3 solutions was measured at 25°, 30° and 35°C. These results, together with the results obtained previously for the solubility of $AgIO_3$ in KNO_3 solutions were used to calculate the thermodynamic constant of HIO_3 at the three temperatures. The value obtained at 25° is in agreement with values given in the literature, and the values for 30° and 35° are in agreement with values extrapolated from the results derived from conductivity data. AUTHORS.

722. Dependence of solubility on molecular weight. G. V. SCHULZ AND B. JIRGENSONS. *Z. phys. Chem. B*, **46,** *pp.* 105–136, *May*, 1940. *In German.*—If a highly polymerized substance is precipitated from a solution a new liquid phase is usually formed containing the substance in a swollen state. The transition energy is dependent on the mol. wt. An approximate equation previously developed is verified by measurements made with nitrocellulose-acetone-water; starch-triacetate—chloroform—ethyl-ether; polystyrol-benzene-cyclohexane. The mol. wt. may be found from measurements of the solubility. Some phenomena affecting the establishment of a more accurate equation are discussed. R. N.

723. Highly diluted liquid mixtures. H. HARMS. *Z. phys. Chem. B*, **46,** *pp.* 82–104, *May*, 1940. *In German.*—The changes in molar space required and of molar heat of solution as dependent on concentration are determined by precision measurements of densities of highly diluted mixtures. These measurements are carried out with an accuracy of $3:10^7$, using a precision balance for comparing the weights of 2 hydrometers floating in liquids of different densities, the temperature difference being measured by thermocouples. The molar space required by ethanol is given, together with heat required for evaporating 1 mole from solutions of different concentration. R. N.

724. Vapour-phase composition of CO_2-H_2O mixtures at various temperatures and at pressures to 700 atm. R. WIEBE AND V. L. GADDY. *J. Amer. Chem. Soc.*, **63,** *pp.* 475–477, *Feb.*, 1941.—The composition of the phase rich in CO_2, here called the vapour phase, was determined at 25°, 31·04° (critical temperature), 50° and 75° C. up to a pressure of 700 atm. The behaviour of CO_2-H_2O mixtures is discussed in connection with the general thermodynamic equation of binary mixtures. AUTHORS.

725. Pressure-volume-temperature relations in solutions. IV. Apparent volumes and thermal expansibilities of NaCl and NaBr in aqueous solutions between 25° and 95°. R. E. GIBSON AND O. H. LOEFFLER. *J. Amer. Chem. Soc.*, **63,** *pp.* 443–449, *Feb.*, 1941.—[See Abstr. 4627 (1939)]. The results are given by equations expressing the sp. vol. as a function of the temperature and as a function of concentration. From these equations the thermal expansibilities, the apparent and partial volumes and expansibilities may be computed at different temperatures and concentrations. An analysis of the results in terms of the electrostrictive effects of the ions and their effects on molecular distribution in the solution gives an explanation of some features of the results, especially the max. in the apparent volume/temperature curves, and suggests that, although the bromide ion has a slightly larger effect in breaking down the water structure than the chloride ion, the main differences between the two solutions are attributable to the larger polarizing power of the chloride ion. AUTHORS.

***726. Solubility of CO_2 and N_2O in aqueous salt solutions.** A. E. MARKHAM AND K. A. KOBE. *J. Amer. Chem. Soc.*, **63,** *pp.* 449–454, *Feb.*, 1941.—An apparatus for the measurement of gas solubility in liquids has been designed in which solubility measurements check within about 0·2%. The solubility of CO_2 and N_2O in various aqueous salt solutions has been measured at 0·2°, 25° and 40° over a wide range of salt concentrations. It is shown that the reduction in gas solubility is an additive function of the ion concentrations up to 1 molal. A new equation is given to express gas solubility in salt solutions as a function of concentration. This equation in most cases fits the data within the experimental error. AUTHORS.

727. Crystallization in silicate slags and glasses. E. PRESTON. *Trans. Faraday Soc.*, **37,** *pp.* 209–220, *April*, 1941.—Eutectic separation is clearly shown to be the simultaneous deposition of different crystalline phases from the liquid phase saturated with respect to each constituent, and each material preserves its own crystalline form in contrast to the more generally observed characteristic eutectic structures obtained by the rapid cooling of very much more fluid metallic alloys. An empirical equation is given, relating rate of crystal growth to the temperature and viscosity of the supercooled liquid phase, which has some theoretical significance and which may be applied to a wide range of silicate glasses. It is probable that such an equation may be of general application to the case of crystallization of supercooled solutions. AUTHOR.

728. Separation of highly polymerized compound mixtures by fractional precipitation. G. V. SCHULTZ. *Z. phys. Chem. B*, **46**, *pp.* 137–156, *June*, 1940. *In German.*—The laws governing fractionating by distribution between 2 non-miscible liquids are given and extended to cover the case of fractional precipitation. The fractionating is more complete the larger the difference between the volumes of the 2 phases, provided the volume of that phase which contains the dissolved molecules of higher potential energy is the greater. Then the large and less mobile molecules increase in the phase of lower potential energy while the smaller molecules, of greater kinetic than potential energy, are found mainly in the phase with the greater volume. The statistical distribution of mol. wts. in the fractions resembles Gauss' error curve. R. N.

SURFACE PROPERTIES.

729. Studies on the lyotropic series. III. The adsorption of salts on cellulose. E. HEYMANN AND G. C. MCKILLOP. *J. Phys. Chem.*, **45**, *pp.* 195–203, *Feb.*, 1941.—The order of adsorption generally agrees with the lyotropic series and confirms that the theory of Katz is, in general, a satisfactory basis for an explanation of lyotropic action. For the anions and for the bivalent cations the adsorption is mainly determined by their affinity for the solvent, ions with a high energy of hydration being weakly, and ions with a small energy of hydration being strongly adsorbed. For the univalent cations no such simple relation has been found. AUTHORS.

730. Heat of wetting of wood charcoal by some common liquids. R. I. RAZOUK. *J. Phys. Chem.*, **45**, *pp.* 179–189, *Feb.*, 1941.—A critical review of various theories and methods of measurement is given. An apparatus is described and a new technique developed for measuring the heat of wetting of thoroughly outgassed charcoal. The heat of wetting is explained in terms of the change in the free energy of the surface of charcoal and its temperature coefficient as measured by the expansion which the charcoal undergoes when it is immersed in the liquid. AUTHOR.

731. Heat of wetting of partially saturated charcoal. R. I. RAZOUK. *J. Phys. Chem.*, **45**, *pp.* 190–194, *Feb.*, 1941.—Measurements have been made of the heat developed when a piece of wood charcoal containing various amounts of methyl alcohol is immersed in the same liquid without exposing the charcoal to air. The differential heat of wetting is found to be constant and equal to the calculated net heat of adsorption for the later stages of adsorption. No measurable heat is developed when the saturated charcoal is plunged in the liquid adsorbate at the same temperature. AUTHOR.

*732. **Measurement of surface tension by the ripple method.** E. TYLER. *Phil. Mag.*, **31**, *pp.* 209–221, *March*, 1941.—The surface tension of a liquid (water and chloroform) is computed by employing graphical methods evolved from Kelvin's equation for the velocity of surface waves under the combined influence of gravity and surface tension. Measurement of the frequency of ripple formation and corresponding wavelength is effected over a wide range (frequency 20 to 400 c./s.) by 3 different stroboscopic methods: (*a*) a synchronous dual-reed device operated at the a.c. mains supply frequency, (*b*) an electrically maintained reed or rod interrupter method at the lower frequencies, (*c*) a synchronous photocell rotating slotted disc and dipper arrangement for frequencies above 100 c./s. The results show good agreement with those obtained by other methods. AUTHOR.

733. Densities, surface tensions and parachors of diborane, boron triethyl and boron tribromide. The atomic parachor of B. A. W. LAUBENGAYER, R. P. FERGUSON AND A. E. NEWKIRK. *J. Amer. Chem. Soc.*, **63**, *pp.* 559–561, *Feb.*, 1941.—The change of environment of B has been shown to be accompanied by a change in parachor which, qualitatively, is that to be expected from the change in bond radius. This supports the suggestion that the parachor has the dimensions of volume. The large variation of observed parachor with change in bond type makes the use of parachor measurements for determination of molecular structure unsound in many cases. AUTHORS.

734. New method for measuring effective areas of film-forming molecules. N. F. MILLER. *J. Phys. Chem.*, **45**, *pp.* 289–299, *Feb.*, 1941.—A method is described for measuring the effective surface areas at film pressures of $10{\cdot}3 \pm 0{\cdot}3$ dynes/cm. The method requires no complicated apparatus. A theory is presented to explain the formation of stable lenses of solutions composed of polar substances in non-polar liquids on neutral or acid substrates. It is shown that the equilibrium of such lens-film systems is not truly reversible but shifts in the direction of higher film pressures and larger lens angles. Equations derived by application of Neumann's theory to these lens-film systems on neutral or acid substrates have been found to satisfy the data obtained for 9 systems at the equilibrium lens end-point. Six criteria are described for distinguishing the equilibrium lens from all preceding lenses. AUTHOR.

735. Mechanism of breakdown of organic protective films in water. J. T. Kendall and L. Massey. *Trans. Faraday Soc.*, **37**, *pp.* 232–244, *April*, 1941.—From the correlation of data it is apparent that for max. water stability of a film the following properties of the component varnish and pigments are desirable: The varnish should have a small water-hydrolysis and low solubility, permeability and absorption. The pigments should have low solubility and when mixed with the varnish should give a low reactivity. These may be taken as the broad fundamental principles on which the formulation of water-resistant films should be based. Authors.

736. Cathode-ray investigation of thin layers found on some single crystals. III. Silver films on sulphide crystals. R. Uyeda. *Proc. Phys.-Math. Soc., Japan*, **22**, *pp.* 1023–1033, *Dec.*, 1940.—Ag films, 10 mμ thick, deposited by evaporation on sulphide crystals at various temperatures, were examined by electron diffraction. For temperatures above a certain critical value (between 20° and 150°C. for the sulphides studied) perfect orientation was found. In general, the film surface is smooth for temperatures below about 100°C. but not above 100°. The patterns obtained for MoS_2, ZnS, PbS and FeS_2, and their interpretation, are discussed in detail. [Abstr. 58 (1940).] E. E. W.

737. Investigation of thin films of cellulose and its derivatives by electron diffraction. I. The three halos. II. The crystalline patterns. J. Kakinoki. *Proc. Phys.-Math. Soc., Japan.*, **22**, *pp.* 1010–1022, *Dec.*, 1940.—A preliminary report [Abstr. 1951 (1939)] gave a quantitative interpretation of electron diffraction halos obtained from nitro-cellulose films. Halo patterns have now been obtained from native-, acetyl-, benzyl-, methyl- and nitro-cellulose, agar, gelatin and polystyrene. The *s*-values for the 3 halos are within 3% agreement for all these substances, with mean values 1·39, 3·12 and 5·30, respectively. The largest halo corresponds to inter-atomic distances 1·46 Å (C–C, C–O, O–O, O–N); the middle halo corresponds to 2·58 Å (C–C, C–O, O–O, O–N, with C, O or N between); the smallest halo corresponds to longer inter-atomic distances.—Crystalline patterns of the above celluloses were obtained by electron diffraction. The corresponding crystal structures are discussed and the results compared with the amorphous halos. E. E. W.

738. Surface elasticity of protein films. II. Properties of partially and of completely spread films. J. B. Bateman and L. A. Chambers. *J. Phys. Chem.*, **45**, *pp.* 209–222, Feb., 1941.—It has been shown [Abstr. 1875 (1939)] that in the spreading of albumin on an air/water interface the globular form of the protein must be distorted to that of a flat sheet or extended chain. This distortion may occur automatically following the breaking of a single bond or through the breaking of a series of bonds and the formation of a series of intermediate products. The distinction of the two mechanisms was attempted by a study of the mechanical properties of films through the variation of max. surface elasticity with apparent limiting area at various *p*H of substrate and at a given *p*H in presence of electrolytes. Expansion patterns with indicator oils were also examined. Results favour the idea of a nearly continuous series of states, connecting the native with the completely spread or surface-denatured protein particle, and are discussed with reference to expanded patterns and theories of film structure. The ratio of the true to apparent limiting area may vary widely for a given substrate and available area. N. M. B.

739. Distillation of foaming solutions under vacuum. D. R. Rexford. *Industr. Engng Chem.* (*Analytical Edition*), 33, *pp.* 95–96, *Feb.* 15, 1941.—A device for the prevention of excessive foaming is described which operates on the principle that, in the distillation of foaming solutions under vacuum, a slight decrease in vacuum temporarily arrests formation and destroys built-up foam masses. Author.

740. Conversion time formulae for heterogeneous reactions at phase boundaries of solids. K. L. Mampel. *Z. phys. Chem. A*, **187**, *pp.* 43–57, *July*, 1940. *In German.*—Although heterogenous reactions at phase boundaries of solids are very frequent, e.g. rusting of iron, corrosion of metals, reduction of ores and a number of other processes, the processes and the time required for the conversion are little known. A distinction is made between the induction period, in which germs are formed and start spreading, and the main period, during which the boundaries between decomposed and sound substance grow with constant speed. For the case of thin sheets or small spheres Bradley, Colvin and Hume gave conversion time formulae. By means of a probability consideration the author modifies these formulae in order to reduce the number of simplifying assumptions required and treat the induction period and the main period uniformly. The only assumptions made are: (1) the formation of equal numbers of germs in equal times and for equal sizes of sound surface of the reacting substances, and (2) a constant speed of growth. R. N.

ASTRONOMY AND ASTROPHYSICS.

COMETS AND METEORS.

741. Comet Cunningham, 1940c. R. J. NORTHCOTT. *J. Roy. Astr. Soc. Can.*, **35,** *pp*. 49–52, *Feb*., 1941.—Sketches are reproduced showing the development of the comet during Nov. and Dec., 1940. The observed magnitudes follow the $\rho^2 r^6$ law in early Nov. and gradually approach the $\rho^2 r^4$ law as the comet approached the sun. A. HU.

PLANETS.

742. 1939–1940 apparition of Jupiter. W. H. HAAS AND H. M. JOHNSON. *J. Roy. Astr. Soc. Can.*, **35,** *pp*. 53–70, *Feb*., 1941.—The paper summarizes the results obtained by 4 observers in the U.S. using instruments of apertures between 5 in. and 12 in. and observing visually and photographically. The latitudes of the various belts were obtained photographically, whilst their rotation periods were obtained by transit observations of semi-permanent marks. The histories of the Red Spot and the S. Tropical Disturbance are traced through the last 4 apparitions. Changes of colour and of intensity in the various belts are described and the difficulties met with in estimating these attributes are emphasized. A plea is made for more American observations of the planet. A. HU.

STARS.

743. Interstellar absorption lines of molecular origin. P. SWINGS. *J. Roy. Astr. Soc. Can.*, **35,** *pp*. 71–80, *Feb*., 1941.—Developments in interstellar spectroscopy during the past 6 years are reviewed. Interstellar molecules, at first considered as the explanation of diffuse lines in the spectra of distant stars, are now regarded as explaining many faint sharp lines in the photographic region. Tentative identification of CH is confirmed by the discovery of further predicted lines of this molecule; the evidence for CN is almost as good. The author suggests a search for NH, OH and C_2. The conditions necessary for the production of broad lines by interstellar molecules are investigated, but no identifications emerge from a systematic search. Absorption by solid particles is also considered; a possible identification of a band as due to solid oxygen is suggested, and the need for further laboratory work on the optical spectra of solids at low temperatures is emphasized. A. HU.

GEOPHYSICS.

LAND, PHYSICS OF THE.

744. Geochemical calculations concerning the total mass of sediments in the earth. P. H. KUENEN. *Amer. J. Sci.*, **239,** *pp*. 161–190, *March*, 1941.—The total amount of all sediments is tested by using Clarke's sodium method. Several corrections are introduced into the latter. The conclusion is that the value formerly assumed was too high. The new value for the average speed of oceanic deposition is 1 cm. solid material in 6000 years. The total thickness of sediments, including pore-space, averages 3 km.; the volume of all sediments is about 13×10^8 km³. It is shown that lime was stored up from the Cambrian to the Cretaceous and is now being transferred to the deep sea, a process that will bring on a lime famine in some 150 million years. The concentration of sandstone on the continents began directly and progressed gradually. The analyses of a composite sample of red clays must give too high a percentage of manganese. AUTHOR.

745. Submarine seismic investigations. E. C. BULLARD AND T. F. GASKELL. *Proc. Roy. Soc. A*, **177,** *pp*. 476–499, *March* 18, 1941.—The refraction seismic method has been used to investigate the form of the surface of the hard rocks underlying the sediments on the continental shelf to the W. of the English Channel. This surface is found to slope steadily downwards on receding from the land and to reach a depth of over 8000 ft. at the 100 fm. line. The velocity of elastic waves in the sediments is about 6000 ft./sec. near the surface and up to 9700 ft./sec. lower down, compared with 16000–22000 ft./sec. in the basement. The bearing of these results on the structure and history of the shelf is discussed. AUTHORS.

METEOROLOGY.

***746. New method of measuring the mean height of the ozone in the atmosphere.** J. STRONG. *J. Franklin Inst.*, **231,** *pp*. 121–155, *Feb*., 1941.—The method described is used in direct sunlight and the height determination can be made at all positions of the Sun. The intensity of absorption of sunlight is measured from 3 absorption bands, (1) the Hartley band for ultra-violet light which gives the total ozone overhead, (2) the near infra-red at $1 \cdot 14\,\mu$ which gives the total water vapour overhead and (3) the infra-red at $9 \cdot 6\,\mu$ for ozone and water vapour. The apparatus, its control and calibration and the technique of measurements, are described. The mean height for the ozone is 25 km. Sources of error are discussed. R. S. R.

747. Practical determination of height from upper-air data. P. M. A. Burke. *Mon. Weath. Rev., Wash.*, **68,** *pp.* 271–272, *Oct.*, 1940.—Expressions are obtained for the determination of height in terms of temperature and potential temperature. Gold's rule for the approximate determination of height is discussed and it is shown that (1) when applied to an isentropic atmosphere it leads to a figure 2·8% below the true height, (2) the error is usually about 2% or less for the lower levels and about 1% for the higher levels (5000–200000 ft.) of an average curve, and (3) when applied to the upper levels of a very stable curve (e.g. an extensive inversion) the rule leads to an overestimation of the height, which may be 4% or more in an extreme case. Thus in the lowest levels the absolute error is usually small and of the order of 100–200 ft. R. S. R.

748. Relation between equivalent potential temperature and wet-bulb potential temperature. H. H. Bindon. *Mon. Weath. Rev., Wash.*, **68,** *pp.* 243–245, *Sept.*, 1940.—Rossby's equation for the equivalent potential temperature is derived. The tephigram is used to determine graphically the equivalent potential temperature and the wet-bulb potential temperature for a given sample of air. Expressions relating the 2 quantities are obtained. R. S. R.

749. Radio in upper-air investigation. S. V. C. Aiya. *Curr. Sci.*, **9,** *pp.* 561–566, *Dec.*, 1940.—The use of the radio-sonde, a small radio transmitter, carried to the upper atmosphere in a balloon, and capable of signalling the recordings of instruments in the balloon, is discussed. A. J. M.

750. Evaluation of the Bergeron-Findeisen precipitation theory. A. R. Stickley. *Mon. Weath. Rev., Wash.*, **68,** *pp.* 272–280, *Oct.*, 1940.—The Bergeron-Findeisen concept of precipitation, regarding the temperature required for rain to fall, and Findeisen's amplification by the introduction of condensation and sublimation nuclei, are discussed in detail. The results were tested by an analysis of a large number of aircraft flights in rain. It is concluded that (i) the Bergeron-Findeisen process actually occurs in the atmosphere, (ii) results of Cl_2 content observations and the relation of the height of the 0°C. isotherm to the height of the tops of the precipitation-forming clouds show this process to be, at least, the main one for rain of any considerable intensity, and (iii) alternative processes, such as the Reynolds effect and coalescence within the size distribution range, are confined mainly to slight rain or drizzle. More accurate observations from aircraft and an investigation of the nature of sublimation nuclei are needed. R. S. R.

***751. Further studies on the condensation hygrometer.** T. Okada and M. Tamura. *Proc. Imp. Acad. Tokyo*, **16,** *pp.* 208–213, *June*, 1940.—The first part of this paper deals with certain corrections to formulae used in a previous note [Abstr. 2617 (1940)]. Allowance is now made, in deducing the expression for the value of the vapour tension, for change of volume on condensation of aqueous vapour. Also, account is taken of the effect of thermal expansion on the manometer liquid, and an expression is derived giving the magnitude of this effect. Slight minor improvements have been made in the construction of the apparatus. A set of comparative observations on the tension of aqueous vapour was carried out using the hygrometer and Assmann's psychrometer. With the latter instrument Sprung's formula was used. The results are given in tabular form. A. E. M. G.

See also Abstract 773.

SEISMOLOGY.

752. Mathematical problems in seismology. A. Blake. *Trans. Amer. Geophys. Un.*, *pp.* 1094–1113, 1940.—The author calls attention to certain mathematical methods available for use in seismology and to a number of unsolved or partially solved seismological problems mainly of mathematical interest. Further advance is desirable concerning surface waves in water-soaked terrain, microseisms, explanation of anomalous motion and applications of atomic theory. The theory of instrumental seismometry requires extension, with regard to both its application to instruments already in existence and its development to new types, notably the strainmeter and the rotation seismograph. The complex problems of the response of engineering structures await solution. In statistical seismology, especially the periodicity problem, new distribution functions are required for the detection of effects not brought out by classical methods. R. S. R.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

See Abstract 712.

RADIOACTIVITY.

753. Radioactive determination of small amounts of U. W. D. Urry. *Amer. J. Sci.*, **239,** *pp.* 191–203, *March*, 1941.—The determination of amounts of U of the order of p. p. 10 mill. has usually been carried out by indirect radioactive measurements. Such measurements cannot be employed except when the radio-elements are known to be in equilibrium. The separation of the U and its isotopes in such small amounts, and in a radioactively pure state, is accomplished with the use of co-precipitators, the Fe (and Al) of the sample itself being the final carrier agent. The α-particle activity of the U is determined as a measure of its concentration. The method is tested by determining the ratio of the α-particle activity of the U-238 to that of the Ra in geological specimens older than 10^8 years, where this ratio should be unity. A mean value of 0·98 ± 0·06 for this test substantiates the validity of the method.

Author.

754. Heat of fission of U. M. C. Henderson. *Phys. Rev.*, **58,** *pp.* 774–780, *Nov.* 1, 1940.—The heat produced during slow neutron bomment in a 13·36 g. sample of metallic U was measured on a resistance thermometer. Simultaneously the number of fissions produced in a 54 mg. layer of U was counted by an ionization chamber and pulse amplifier. The source of neutrons was the Princeton cyclotron, using the Be–H reaction at 6·5 eMV. The U layer gave 40·1 ± 0·2 α-particles per min. into 2π solid angle and under slow neutron bombardment gave about 340 fissions per min. At the same time the heat output from the 13 g. sample was 40 μW. A method of calculation was developed that allows for the transient effects of fluctuations in the neutron output of the cyclotron. The weighted average of 13 runs is 177 eMV per fission. The actual kinetic energy of recoil carried by the fission fragments is about 12 eMV less than this, ± 50%, depending upon more precise knowledge of the fission mechanism.

Author.

755. Disintegration of N^{14} and N^{15} by deuterons. M. G. Holloway and B. L. Moore. *Phys. Rev.*, **58,** *pp.* 847–860, *Nov.* 15, 1940.—A mixture of N^{14} and N^{15} gas was bombarded with deuterons of 1 eMV and the disintegration particles observed at rt. angles to the direction of the deuteron beam. The ranges of the disintegration particles were measured by means of a shallow ionization chamber and pulse amplifier. The shortest measurable range was 2·1 cm. (15°C., 760 mm. Hg). The reaction $N^{15}(d, \alpha)C^{13}$ gave rise to one group of α-particles at 5·25 cm. range with a Q value of 7·54 eMV. Three groups of α-particles (11·97 cm., 6·54 cm. and 3·47 cm. range) were observed arising from the reaction $N^{14}(d, \alpha)C^{12}$. The Q values corresponding to these groups are 13·39 eMV, 9·02 eMV and 5·77 eMV, respectively. From the reaction $N^{14}(d, p)N^{15}$ 2 valid groups of protons were observed having ranges of 90·5 and 21·02 cm. with Q values of 8·51 and 3·15 eMV. A group of 66 cm. due to this reaction was found to be due to B contamination. No proton groups were found which could be attributed to the reaction $N^{15}(d, p)N^{16}$, although a radioactivity of half-life 9·5 ± 1·0 sec. was found to result from deuteron bombardment of the mixture of N^{14} and N^{15}. This radioactivity was not found when N^{14} alone was bombarded. A method of range measurement is described which allows accurate corrections to be made for the effect of chamber depth and of the bias on the grid of the counting thyratron on the output of the pulse amplifier.

Authors.

756. Transmutation of fluorine by protons. J. F. Streib, W. A. Fowler and C. C. Lauritsen. *Phys. Rev.*, **59,** *pp.* 253–270, *Feb.* 1, 1941.—The excitation functions for the production of long-range α-particles, γ-rays and electron pairs, by the bombardment of F^{19} by protons have been observed simultaneously up to a bombarding energy of 1·5 eMV. The long-range α and pair curves exhibit resonance peaks superimposed on a background of increasing intensity with increasing bombarding energy. Approximate coincidence in 2 instances of pair and α-resonances suggests that full-range alphas and the short-range alphas preceding pair emission can be products of competing modes of decay of the same intermediate states of Ne^{20}. This in turn suggests that the state of O^{16} which decays by pair emission has the same parity (even) as the ground states of O^{16} and thus that the pair emission can be due to ordinary electromagnetic forces.

Authors.

757. Long-lived radioactive carbon : C^{14}. S. Ruben and M. D. Kamen. *Phys. Rev.*, **59,** *pp.* 349–354, *Feb.* 15, 1941.—A long-lived activity was obtained by deuteron bombardment of graphite. The same kind of activity has been obtained by slow neutron irradiation of nitrogenous compounds. The radiations consist of low-energy negative electrons with a range of 19 ± 2 mg./cm^2. Al (145 ± 15 ekV upper energy limit). No soft or hard γ-rays could be detected. The nuclear reactions must be C^{13} (d, p) C^{14} and N^{14} (n, p) C^{14}. A sample was followed in a screen-wall Geiger counter for 9 months and showed no decay. From cross-section and yield estimates the half-life of C^{14} is probably 10^3–10^5 years. The production, isolation and detection, of C^{14} for tracer work are described. AUTHORS.

758. Successive transformations in nuclear fission. N. BOHR. *Phys. Rev.*, **58,** *pp.* 864–866, *Nov.* 15, 1940.—If it be assumed that fission of heavy nuclei takes place in competition with the escape of a neutron from the highly excited compound system, we should expect that, for sufficiently high excitation of the system, fission of the residual nucleus left after neutron escape might still occur. Since, in this second stage of the process, the conditions for the competition with neutron escape are in several cases more favourable than in the first stage, such effects may give rise to much increased cross-sections for the fission process. [See Abstr. 3979 (1939.)] AUTHOR.

759. Velocity/range relation for fission fragments. N. BOHR. *Phys. Rev.*, **59,** *pp.* 270–275, *Feb.* 1, 1941.—Considerations indicated in an earlier note [see Abstr. 3213 (1940)] are developed in greater detail and a comparison is given between the calculations and more recent experiments. A more precise estimate is given for the charge effective in electronic encounters, which determine the stopping effect over the first part of range, and for the screening distance in nuclear collisions responsible for the ultimate stopping. Fission fragment tracks show, in contrast to α-rays, a considerable range straggling originating in the end part of the range. It is shown that in this respect also the calculation agrees closely with the experimental data. AUTHOR.

760. Velocity/range relation for fission fragments. N. BOHR, J. K. BØGGILD, K. J. BROSTRØM AND T. LAURITSEN. *Phys. Rev.*, **58,** *pp.* 839–840, *Nov.* 1, 1940.—[Abstr. 3212 (1940).]

761. Range and straggling of fission fragments. J. K. BØGGILD, K. J. BROSTRØM AND T. LAURITSEN. *Phys. Rev.*, **59,** *pp.* 275–277, *Feb.* 1, 1941.—The authors investigate the paths in He and A of the fission particles from U, due to bombardment with slow neutrons. Their results confirm the earlier findings that there are 2 kinds of tracks, of which one has 2 to 3 times as many branches as the other, over most of the range. This track is also consistently the shorter of the two. The sums of the lengths of pairs of tracks are shown to have much less spread than the lengths of the individual tracks. The difference in the length of the tracks in A and He show that the stopping power of He relative to A is lower for fission particles than for α particles, presumably because of a smaller rate of velocity loss towards the end of the range. The number of branches on the tracks is claimed to be in agreement with theory. G. O. B.

762. Deuteron-induced fission in U and Th. I. C. JACOBSEN AND N. O. LASSEN. *Phys. Rev.*, **58,** *pp.* 867–868, *Nov.* 15, 1940.—By means of deuteron beams from the cyclotron the variation of fission yield with deuteron energy is determined for U and Th. In both cases a rapid rise is found in the region from 8 to 9·5 eMV. For an energy of 9 eMV the cross-section in U is estimated to be 5×10^{-27} cm^2., and for this energy the ratio between the cross-sections for U and Th is found to be 0·7, supporting the theoretical expectation that we have in these fission processes to do with successive transformations. AUTHORS.

763. Operation of proportional counters. S. A. KORFF. *Rev. Sci. Instrum.*, **12,** *pp.* 94–96, *Feb.*, 1941.—The operation of proportional counters is described. The voltage region for proportional operation is determined, and a procedure is described for determination of the amount of ionization in the initial ionizing event. AUTHOR.

***764. Apparatus for measurement of α-particle range and relative stopping power of gases.** M. Y. COLBY AND T. N. HATFIELD. *Rev. Sci. Instrum.*, **12,** *pp.* 62–66, *Feb.*, 1941.—A description is given of an apparatus for measuring the extrapolated range of α-particles in gases by specific ionization after Curie-Naidu. The specific ionization current is increased about 100-fold without increasing the thickness of the α-particle sources. AUTHORS.

***765. Interval selector: a device for measuring time distribution of pulses.** A. ROBERTS. *Rev. Sci. Instrum.*, **12,** *pp.* 71–76, *Feb.*, 1941.—In conjunction with 2 scaling circuits the apparatus records the total number of pulses in a distribution and also the number of intervals between pulses less than any arbitrary value, the range of which is from 10^{-4} to 0·3 sec. The application of the interval selector to the testing of particle-counting apparatus is described. AUTHOR.

***766. Vacuum tube scaling circuit.** D. DEVAULT. *Rev. Sci. Instrum.*, **12,** *pp.* 83–85, *Feb.*, 1941.—A scaling circuit is described in which certain desirable characteristics are obtained by applying the tripping impulses to the cathodes of the scaling tubes. The circuit is a scale-of-sixteen type employing hard tubes with no inter-stage coupling. AUTHOR.

See also Abstracts 770, 869.

RADIATION.

COLORIMETRY.

∗767. Photo-electric colour temperature meter for incandescent lamps. M. H. Sweet. *J. Opt. Soc. Amer.*, **30,** *pp.* 568–571, *Nov.*, 1940.—Two vacuum photo-tubes are used in a balanced bridge circuit with an electric eye as an output indicator. No electronic amplification is used. Author.

∗768. Simply constructed colour comparator. R. H. Wilhelm. *Industr. Engng Chem.* (*Analytical Edition*), **13,** *p.* 123, *Feb.* 15, 1941.

EMISSION.

769. Radiation from high-pressure mercury arcs. E. B. Noel. *Illum. Engng, N.Y.*, **36,** *pp.* 243–256, *Feb.*, 1941.—[Abstr. 580B (1941).]

770. Mean lifetime of mesotron from electroscope data. H. V. Neher and H. G. Stever. *Phys. Rev.*, **58,** *pp.* 766–770, *Nov.* 1, 1940.—In order to eliminate some experimental difficulties found in detecting the mesotron decay with Geiger counter apparatus, an experiment was performed which consisted of the measurement of cosmic-ray intensity at various depths in two lakes of widely different altitude but same geomagnetic latitude. One of the authors' self-recording electroscopes was used. On the basis of the most recent theory, air and water were assumed to be gramme for gramme equivalent absorbers for the mesotrons involved. The ratio of intensities at equivalent points in the two lakes was calculated, and by matching this with the observed ratios a mean rest lifetime of $2\cdot8 \times 10^{-6}$ sec. was found for a rest mass 160 times that of the electron. Authors.

771. Note on the Neher-Stever experiment. E. Nelson. *Phys. Rev.*, **58,** *pp.* 771–773, *Nov.* 1, 1940.—Three problems important to the quantitative interpretation of experiments on the decay of the penetrating component of cosmic rays are discussed: (*a*) The correct treatment of the altitude effect in the energy distribution is found to be important in the determination of the decay constant of the mesotron; (*b*) the fraction of mesotrons decaying is shown to be independent of the zenith angle; (*c*) the absorption in water of cascades produced by decay electrons is calculated from the shower theory of Serber and is found to be in agreement with the experimental results of Neher and Stever. This last point shows that one but not both of the decay products is shower-producing. Author.

772. Production of secondary ionizing particles by non-ionizing agents in cosmic radiation. B. Rossi, L. Jánossy, G. D. Rochester and M. Bound. *Phys. Rev.*, **58,** *pp.* 761–766, *Nov.* 1, 1940.—Previous experiments have shown that the number of coincidences recorded with a vertical counter arrangement is a few p.c. larger when some absorber is placed above the counters than with the same absorber between them. The effect is also present when the experimental conditions are such as to exclude the possibility of its being due to shower-production by photons. It had, therefore, been ascribed either to penetrating non-ionizing particles (neutrons, neutrettos) producing ionizing secondary rays, or to ordinary photons producing penetrating secondary particles (mesotrons). The present experiments show that a minor part, if any, of the observed influence of the position of the absorber can be due to the above processes. The major part of it arises from the interference of already known phenomena like scattering, knock-on showers, showers from the air, etc. This conclusion refers only to experiments performed near sea level. Authors.

773. Correlation between cosmic-ray intensity at Cheltenham [U.S.A.] and the air temperatures and pressures for 1939. N. F. Beardsley. *Phys. Rev.*, **59,** *pp.* 233–237, *Feb.* 1, 1941.—A calculation has been made of correlations between the cosmic-ray data and radio-sonde data from the Anacostia Naval Air Station. The variation of the cosmic-ray intensity is found to depend as follows: 15% on total air pressure, 40% on the distribution of the air mass as correlated with the surface temperature, 10% on world-wide changes, with 30% still unaccounted for. Increased air mass in the upper air reduces the surface cosmic-ray intensity more than a corresponding increase in air mass at lower levels. The calculations are based on data for 220 days in 1939. Author.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

774. Ultra-violet excitation of fluorescent compounds. J. W. Marden and N. C. Beese. *Illum. Engng, N.Y.*, **36,** *pp.* 235–242, *Feb.*, 1941.—[Abstr. 582B (1941).]

775. Photosensitization and fluorescence by aromatic hydrocarbons. W. West and W. E. Miller. *J. Chem. Phys.*, **8,** *pp.* 849–860, *Nov.*, 1940.—Benzene, naphthalene, related hydrocarbons and some of their derivatives, act as optical sensitizers towards the decomposition of alkyl iodides in hexane solution. Within this group the sensitizing power of a substance towards an acceptor runs parallel with the ability of the acceptor to quench the fluorescence of the sensitizer. Detailed analysis of the quenching and sensitization shows that, while sensitization and fluorescence are alternative processes, they are not completely reciprocal; more molecules may sensitize than may potentially fluoresce. All of the observed features of the sensitization are consistent with its being the result of a resonative transfer of energy at collision from the excited sensitizer to the acceptor. AUTHORS.

776. **Effect of size of particle on intensity of fluorescence of a phosphor.** M. S. OLDHAM AND W. KUNERTH. *J. Opt. Soc. Amer.*, **31**, *pp.* 102–104, *Feb.*, 1941.—The authors have used various sized particles of phosphors and have found that, within the range of sizes used, the smaller the size the greater is the intensity of fluorescence. AUTHORS.

777. **Fluorescence, phosphorescence and photochemistry of dyestuffs.** J. FRANCK AND R. LIVINGSTON. *J. Chem. Phys.*, **9**, *pp.* 184–190, *Feb.*, 1941.—Many facts of the photochemistry, the phosphorescence and fluorescence quenching, of dyes can be interpreted by assuming that an electronically excited dye molecule can pass by internal conversion to the electronic ground state of a reactive energy-rich tautomer. AUTHORS.

INTERFERENCE, DIFFRACTION AND SCATTERING.

778. **Interferometer method of plane stress analysis.** D. SINCLAIR. *J. Opt. Soc. Amer.*, **30**, *pp.* 511–513, *Nov.*, 1940.—Stress diagrams in plastics such as Lucite, which has negligible stress-optical sensitivity, are obtained by rotating the test material in a centrifuge and illuminating it stroboscopically with a synchronized condenser discharge through a quartz capillary arc. Using bakelite, an optically sensitive material, as a comparison, isochromatics and isoclinics are also obtained. Practical details given include compensation with the Mach-Zehnder interferometer used, intensity and quality of illumination and synchronization of the stroboscope. E. H. W. B.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

779. **Reduction of silver ions by hydroquinone and *p*-phenylenediamine in alkaline solution.** T. H. JAMES. *J. Phys. Chem.*, **45**, *pp.* 223–233, *Feb.*, 1941.—The reduction of Ag ions by hydroquinone, durohydroquinone, and *p*-phenylenediamine was studied in alkaline Na_2SO_3 The reactions do not involve the $AgSO_3$ complex to any significant degree. A small amount of catalysis by quinone was established for the durohydroquinone reaction, and the kinetics of the hydroquinone reaction suggest the existence of a quinone catalysis. The Ag-catalyzed reaction involves adsorption of Ag ions. The Ag-catalyzed reduction of Ag ions by *p*-phenylenediamine involves adsorption of the *p*-phenylenediamine. The reaction rate varies as the first power of the Ag-ion concentration and approximately inversely as the square of the sulphite-ion concentration. A strong positive neutral salt effect was observed in the reduction of Ag ions by *p*-phenylenediamine, *p*-aminophenol, *p*-dimethylaminophenol and *p*-phenylenediaminemonosulphonic acid. No action, or a slight negative effect, was observed with hydroquinone, hydroxylamine, and catechol. AUTHOR.

780. **Hypersensitization and reciprocity failure of photographic plates.** I. S. BOWEN AND L. T. CLARK. *J. Opt. Soc. Amer.*, **30**, *pp.* 508–510, *Nov.*, 1940.—Tests are made of various methods of hypersensitizing and their effects on the long-exposure sensitivity of 3 representative emulsions. Attention is directed mainly to the toes of the various H. and D. curves, so that the results are of interest to astronomers and spectroscopists using long exposures on weak sources. Spectrograph exposures are made through stepped slits on a continuous source, the durations being 45 sec., 2 hr., and 16 hr. The resulting densities are measured in the blue, green and red, for a panchromatic emulsion, in the blue for an undyed emulsion, and at one wavelength in the infra-red for an infra-red emulsion. Hypersensitization by pre-heating, by pre-exposure, and by treating with NH_3, Hg vapour, borax and water, all yield a greater speed increase for long exposures than for short. Gains of a factor of 3 or more can be obtained by the appropriate treatment without an objectionable increase of fog or loss of contrast. A. HU.

See also Abstracts 775, 777.

PHOTOMETRY.

*781. **Photo-electric measurement of the average intensity of fluctuating light sources.** J. S. PRESTON. *J. Sci. Instrum.*, **18**, *pp.* 57–59, *April*, 1941.—This note deals with the use of a smoothing condenser to ensure correct averaging, on a time basis, when an emission-type photocell is used with a resistance-coupled amplifier for the measurement of the mean intensity of a periodically fluctuating light source. It is usual to include, in the input grid circuit, a potential divider which is used to balance out and so to measure the volt drop in the coupling resistance due to the photocurrent. The amplifier system is used as a null indicator. To avoid injection into the amplifier of a.c. components of such magnitude as would cause undesirable errors in the indication, when the photocurrent is varying periodically, a smoothing condenser may be used in the input circuit. To avoid serious time lag in the indication, due to dielectric hysteresis in the condenser, the condenser is preferably connected across both the coupling resistance and the potential divider, so that it is not subject to changes in voltage except during the short time necessary for rebalancing the system after a change from light to dark conditions, or vice versa. Even in this position too large a capacity may lead to sluggish operation, and a method is therefore given for calculating approximately the min. safe capacity in a given case and for a given permissible limit of error. For any one set of conditions the product of the capacity and the coupling resistance is a constant. Experience has shown the method and calculations to be simple in application and satisfactory in practice. AUTHOR.

*782. **Ultra-violet photometer.** V. F. HANSON. *Industr. Engng Chem.* (*Analytical Edition*), **13**, *pp.* 119–123, *Feb.* 15, 1941.—The instrument is designed for rapidly measuring concentrations of trichloroethylene as low as 10 p.p.m. and perchloroethylene as low as 0·3 p.p.m. in air. It is applicable to many toxic organic vapours in concentrations as low as 0·13 p.p.m. Its operation depends on the partial opacity of these vapours to ultra-violet light. It is specific for vapours having a strong absorption in the 2 537 Å region of the spectrum. Special measures must be taken when mixtures of such substances are present. AUTHOR.

REFLECTION, REFRACTION AND DISPERSION.

783. Metallic reflection by compressed crystalline powders. J. A. SANDERSON. *J. Opt. Soc. Amer.*, **30**, *pp.* 566–567, *Nov.*, 1940.—Crystalline powders, when pressed into plates at pressures of about 40 000 lb./in^2., reflect strongly in the infrared spectrum at wavelengths characteristic of their functional groups. This points to usefulness of such plates in optical investigations of any materials not available as large crystals. AUTHOR.

784. Simple method for determining chromatic aberration for photomicrographic purposes. W. KOCH. *J. Opt. Soc. Amer.*, **30**, *pp.* 564–565, *Nov.*, 1940.

785. Dispersion of silicate glasses as a function of composition. M. L. HUGGINS. *J. Opt. Soc. Amer.*, **30**, *pp.* 514–518, *Nov.*, 1940.—It was previously shown [Abstr. 3062 (1940)] that one constant per element (other than oxygen) sufficed to calculate the refractive indices (for a single wavelength) of a wide variety of silicate glasses from their compositions and densities. It is now shown that with an additional constant per element (other than oxygen) the dispersions in the visible range can be computed. The average deviation between experimental and calculated values for $n_F - n_C$ is about 5 to 8 × 10^{-5} in those systems for which the most accurate data are available. AUTHOR.

786. Change of index of refraction with concentration in solutions of water and *n*-butyl alcohol at 30°. B. LONGTIN, M. RANDALL AND H. WEBER. *J. Phys. Chem.*, **45**, *pp.* 340–343, *Feb.*, 1941.—Changes of *n* in alcohol-rich and water-rich phases, obtained from measurements with a Zeiss-Rayleigh interferometer, for 1·795–94·310 wt. % of water are reported. N. M. B.

787. Variable-focus lens and its uses. R. GRAHAM. *J. Opt. Soc. Amer.*, **30**, *pp.* 560–563, *Nov.*, 1940.—By placing 2 variable, liquid, cylindrical lenses with their axes crossed at right angles, a lens has been made which produces the effects characteristic of spherical, cylindrical or toroidal lenses and in addition has the property of variable focus. The useful range of powers is about 7 diopters, and the accuracy in repeating any power is satisfactory. Its application to ocular refraction is discussed. AUTHOR.

*788. **Instrument for testing the deviation produced by sextant shades.** D. S. PERFECT. *J. Sci. Instrum.*, **18**, *pp.* 59–63, *April*, 1941.—A modification of the method of setting employed originally by Whipple at the Kew Observatory leads to an economy of time in testing, since both components of the deviation are simultaneously examined. This modification necessitates the replacement of Whipple's deflection method of measurement by a null method, and the paper describes a special form of micrometer devised for null deviations. Apart from its special use the instrument is suitable for examining the parallelism of optical plates in general. AUTHOR.

789. Superposition fringes in the internally reflected light from a Fabry-Perot etalon. S. MROZOWSKI. *J. Opt. Soc. Amer.*, **31**, *pp.* 209–212, *March*, 1941.—A system of very sharp dark fringes is observed in the spectra formed by both of the first-order reflections occurring within the quartz plates of a Fabry-Perot etalon. In the second-order reflections, 2 intersecting systems of fringes appear, the fringe separation in one being ½ of that in the other. The first-order fringes are complementary to the fringes observed by Perot and Fabry in the light passing through 2 non-parallel etalons of equal thickness. They arise by passage of the light through the etalon and subsequent reflection from it in the reverse direction. The two systems of fringes in the second-order reflections arise from one passage through the etalon, followed or preceded by 2 successive reflections from it. AUTHOR.

SPECTROSCOPY.

790. Mineral analysis of biological materials. M. A. GRIGGS, R. JOHNSTIN AND B. E. ELLEDGE. *Industr. Engng Chem.* (*Analytical Edition*), **13,** *pp.* 99–101, *Feb.* 15, 1941.—The Lundegårdh air-acetylene burner used for the excitation of the emission spectra of metallic substances in solution is described, together with the Lundegårdh method of calculation of the concentration of these ions in the solutions used. Results for Ca, Cu, Fe, Mg, Mn, K and Na show a recovery of these elements when solutions containing known concentrations are analysed. AUTHORS.

791. Commercial applications of visual spectroscopic analysis. F. H. EMERY. *J. Opt. Soc. Amer.*, **31,** *pp.* 160–162, *Feb.*, 1941.

792. Horticultural applications of spectrochemical analysis. B. C. BRUNSTETTER AND A. T. MYERS. *J. Opt. Soc. Amer.*, **31,** *pp.* 163–166, *Feb.*, 1941.

793. Geochemical study of Saratoga mineral waters by spectrochemical analysis of their trace elements. L. W. STROCK AND S. DREXLER. *J. Opt. Soc. Amer.*, **31,** *pp.* 167–173, *Feb.*, 1941.

794. Theorem on nuclear motion in atomic spectra. J. P. VINTI. *Phys. Rev.*, **58,** *pp.* 882–883, *Nov.* 15, 1940.—A theorem is derived concerning the energy shift of an atomic level due to nuclear motion. Since the expression obtained does not involve derivatives, it may be useful for calculations of isotope shifts due to nuclear motion in those cases where the radial wave functions are known not as analytical expressions but only as tables of numerical values. AUTHOR.

795. Isotope shift in boron. J. P. VINTI. *Phys. Rev.*, **58,** *pp.* 879–881, *Nov.* 15, 1940.—Mrozowski's microphotometer curves for the lines λ2 497, 2 498 of B I due to $2^2P_{\frac{1}{2},\,1\frac{1}{2}} - 3^2S_{\frac{1}{2}}$ and λ3 451 of B II due to $(2s)\,(2p)\,{}^1P_1 - (2p)^2\,{}^1D_2$ showed asymmetries which were resolved into isotope shifts arising from the isotopes 10 and 11 [see Abstr. 2521 (1939)]. Subtraction of the corresponding normal shift from each of the observed values leads to observed specific shifts of − 0·373 cm.$^{-1}$ for λ2 497, − 0·366 cm.$^{-1}$ for λ2 498, and + 0·734 cm.$^{-1}$ for λ3 451. The present note gives a calculation of these specific shifts with the aid of Morse-Young-Haurwitz wave functions. The results are − 0·366 5 cm.$^{-1}$ for either member of λ2 497, 2 498 of B I and + 0·566 cm.$^{-1}$ for λ3 451 of B II. Reasons are suggested why the agreement with experiment is better in the case of the B I lines than in the case of the B II line, and also why the present calculation for the B I lines agrees better than that due to Opechowski and DeVries. The possible spread due to nuclear spin is estimated with the use of triplet separations and Morse-Young-Haurwitz functions and found to be of the order 0·03 cm.$^{-1}$ in each case, thus explaining on the basis of smallness the absence of nuclear-spin h.f.s. in Mrozowski's plates. AUTHOR.

796. New lines and terms in arc and first spark spectra of molybdenum : Mo I and Mo II. M. R. SCHAULS AND R. A. SAWYER. *Phys. Rev.*, **58,** *pp.* 781–783, *Nov.* 1, 1940.—The spectrum of Mo, as excited in a hollow-cathode discharge, was photographed from 540 Å to 10 830 Å. The resonance triplet of Mo II, ${}^6S - {}^6P^0$, was found, thus locating the lowest term, the ${}^6S_{5/2}$, at 11 783·70 cm.$^{-1}$ below the previously known lowest level, the ${}^6D_{1/2}$. Some 20 new lines were classified and 7 new levels established. Two new multiplets, the ${}^6D - {}^6P^0$ and the ${}^6D - {}^6D^0$, were arranged. Catalán's list of classified Mo I lines was extended to include 36 additional lines. These lines were classified from levels previously determined by Catalán. AUTHORS.

797. Pressure effects of homogeneous Rb vapour on its resonance lines. CH'EN SHANG-YI. *Phys. Rev.*, **58,** *pp.* 884–887, *Nov.* 15, 1940.—The broadening of the resonance lines of Rb in absorption under pressures up to 150 mm. of its own homogeneous vapour was studied by means of a 21 ft. grating. Under pressures below 1 mm. the broadening of the lines was symmetrical and the line contours could be described by the dispersion formula, but when the pressure was high the lines exhibited asymmetrical broadening of van der Waals type. The ${}^2P_{1/2}$ component showed red, while the ${}^2P_{3/2}$ component showed violet, asymmetry. Both lines showed the proportionality of the width concentration of Rb atoms. The experimental width at ½ max. is greater than that predicted by Houston's theory by a factor of 1·5, and the width of the transition from ${}^2P_{3/2}$ is greater than that from ${}^2P_{1/2}$ by a factor of 1·6. A narrow diffuse band was observed near the shorter-wavelength side of the ${}^2P_{1/2}$ component and a similar one near the longer-wavelength side of the ${}^2P_{3/2}$ component. AUTHOR.

798. Term values in V II and Mn II. D. S. BOWMAN. *Phys. Rev.*, **59,** *pp.* 386–388, *Feb.* 15, 1941.—The term values for d^3s and d^5s are calculated in Russell-Saunders coupling. For some of the terms of the same kind in d^5s only the sum of the energies is obtained. The first approximation to the separations of the levels is also found for d^3s. The formulae including Ostrofsky's results for d^4 are applied to the observed values of V II and Mn II. AUTHOR.

799. Radiation properties of heavy nuclei. V. F. WEISSKOPF. *Phys. Rev.*, **59,** *pp.* 318–319, *Feb.* 1, 1941.—A method of estimating the order of magnitude of the radiative transition probabilities between nuclear levels of heavy nuclei is proposed. It depends on the assumption that the absorption probability of a nucleus in its ground state, averaged over an energy interval which contains a great number of excited levels, is proportional to the intensity at the nucleus of the spherical harmonic component of the light wave which is absorbed. The wavelength is also assumed to be large compared with the nuclear radius. These assumptions lead to a formula for the absorption cross-section into an energy region of the nucleus E eMV above the ground state. From this cross-section the average emission probability for such an excited state can also be found by a simple formula. The two formulae are tested against 3 sets of experimental results with a fair agreement. G. O. B.

800. New electronic transitions of the BH molecule. A. E. DOUGLAS. *Canad. J. Res. A*, **19,** *pp.* 27–31, *Feb.*, 1941.—In a discharge in He with a trace of $B\,Cl_3$ and H 3 new bands are found at 3415 Å, 3396 Å and 3099 Å. Measurements of these bands show that they are due to 2 new electronic transitions of the BH molecule. The upper states of both transitions are previously unknown $^1\Sigma^+$ states. The lower state of both transitions is the same and is a known $^1\Pi$ state. The rotational constants of both new states have been determined and their electron configuration is suggested. AUTHOR.

801. Absorption spectra of the Cr alums at low temperatures. D. L. KRAUS AND G. C. NUTTING. *J. Chem. Phys.*, **9,** *pp.* 133–145, *Feb.*, 1941.—Line absorption spectra of 13 sulphate and selenate Cr alums have been measured at 15°–20°K. Pronounced differences in the spectra are attributed to structural differences in the crystals and are related to the size of the anions and the univalent cations. Anomalous behaviour on change of temperature is shown by K_2SO_4 and $(NH_4)_2SO_4$ and selenate alums. Transitions disrupting the lattice and significantly altering the spectrum occur in ammonium chromium sulphate at 81° ± 1°K. and in ammonium chromium selenate at 106° ± 5°K. Combination of electronic frequencies of Cr^{+++} with internal oscillations of anions are weak. Combination of lattice vibrations with both upper and lower electronic states of Cr^{+++} are found. Bands are observed in all the alums shifted about 330, 570 and 800 cm.$^{-1}$ to higher frequencies than the electronic absorption lines. These are thought due to photo-excitation of a non-homopolar complex, probably $Cr(H_2O)_6{}^{+++}$. Repetition of the electronic multiplet and associated vibrational structure at some of these higher frequencies is found in several of the alum spectra. AUTHORS.

802. Spectrophotometric study of glutathione. G. A. ANSLOW AND E. R. LYMAN. *J. Opt. Soc. Amer.*, **31,** *pp.* 114–117, *Feb.*, 1941.—The ultraviolet and visible absorption spectra of glutathione in aqueous, alcohol and alkaline solutions show 4 regions of selective absorption at 500, 325, 280 and 252 mμ, associated with absorption of energy in the $\alpha - \beta$ C bond of the glutamic acid radical, the $-$ SH group of the cysteyl radical, the peptide linkage, and the S $-$ S bond of oxidized glutathione, respectively. The peptide band at 280 mμ consists of 2 components whose location, definition and intensity, depend upon the solvent. This band is shifted toward the visible in alkaline and alcohol solutions as is the ultraviolet continuum. The location of the latter indicates that the energy absorbed in the peptide dissociates glutathione into its constituent amino acids. Oxidation follows the absorption of energy of wavelength about 325 mμ; the subsequent reduction of the oxidized molecules is affected by energy of wavelength 252 mλ. These conclusions are supported by f.p. measurements of the van't Hoff dissociation factors of glutathione, glutamic acid, cysteine HCl, and glycine solutions before and after irradiation. AUTHORS.

803. Absorption of ultra-violet energy by the peptide linkage. G. A. ANSLOW AND S. C. NASSAR. *J. Opt. Soc. Amer.*, **31,** *pp.* 118–123, *Feb.*, 1941.—The absorption spectra of the proteins, egg albumin, lactalbumin and gelatin, were studied and compared with those of related amino acids and simple peptides; the effect of various solvents on these compounds was investigated. AUTHORS.

804. Infra-red absorption spectra of some amino compounds. L. KELLNER. *Proc. Roy. Soc. A*, **177,** *pp.* 447–456, *March* 18, 1941.—An investigation of the infra-red absorption spectra of 5 amino compounds (glycine, diketopiperazine, tetramethyl-diketopiperazine, glycylglycine and urea) has been made in the region 2·8–3·6 μ. The substances were used in the form of thin crystalline layers deposited on quartz windows. The spectra are discussed with regard to the molecular structure of the compounds under consideration. The number and position of the N—H frequencies in glycine and glycyl-glycine are in agreement with the assumption that these two molecules are in the zwitterion form in the crystal. The close similarity between the spectra of diketopiperazine and tetramethyl-diketopiperazine and tetramethyl-diketopiperazine on the one hand, and the amino acids and urea on the other, proves that no lactam-lactim interchange occurs in diketopiperazine and its derivative. Both compounds are shown to possess a centre of symmetry. It follows from the experimental evidence that in all the substances investigated resonance between the C—N and C = O bonds takes place. AUTHOR.

805. Spectroscopical determination of association equilibria. H. KEMETER AND R. MECKE. *Z. phys. Chem. B*, **46**, *pp.* 229–241, *June*, 1940. *In German.*—Photo-electric absorption measurements with a solution of phenol in CCl_4 in different concentrations provide accurate data concerning the association equilibrium of compounds containing groups of OH. The measurements are made at the sharp OH band λ9 680 and it is shown why this is preferable to the broader association bands. The questions whether the law of mass action is valid and whether the spectroscopical method is applicable for investigating stoichiometric relations between associated and unassociated parts in the solution are both answered in the affirmative. The method is especially suitable for low concentrations. For the whole reach of concentration the process of association may be represented by the general bimolecular accumulative reaction $Ph_n + Ph \rightleftarrows Ph_{n+1}$. R. N.

806. Zeeman effect in the Rh arc spectrum at high fields. J. P. MOLNAR AND W. J. HITCHCOCK. *J. Opt. Soc. Amer.*, **30**, *pp.* 523–535, *Nov.*, 1940.—The Zeeman effect for the arc spectrum of Rh has been photographed with a large Bitter type magnet at field intensities up to 94 000 gauss. Data are given on the Zeeman patterns of 446 lines, from which *g* values are calculated for nearly all the known low and middle spectral terms of the Rh atom. For terms arising from the low even configuration the *g* values are found to be given by *LS* coupling formulae, except for the terms having $J = 2\frac{1}{2}$ or $1\frac{1}{2}$, in which case a perturbation between the overlapping d^9 and $d^8 5s$ configurations destroys the agreement. The *g* sum rule is found to be valid when the terms from the two configurations are taken together. For the odd configurations the *g* values lie between those predicted by *LS* and *Jj* coupling formulae. The classification of lines by other investigators has been thoroughly checked, and a new term list is given with 14 additional terms. The old term values have been recalculated on the basis of new wavelength data. AUTHORS.

807. Interactions in tungsten atom, W I, in magnetic field. J. H. ROBERSON, J. E. MACK AND G. R. HARRISON. *Phys. Rev.*, **58**, *pp.* 895–903, *Nov.* 15, 1940.—General theoretical expressions are given for the magnetic-field dependence of the energies and intensities belonging to neighbouring levels (regardless of coupling) of an atom. The energy-dependence is tested experimentally for the levels $21\,448_2$ and $21\,453_1$ of W I in fields up to 4·5 cm.$^{-1}$ (= 9·7 × 10^4 c.g.s.), where the pattern levels extends more than 30 cm.$^{-1}$ The deviations $\nu_{obs} - \nu_{calc}$, obtained from individual determinations at different field strengths, are in some instances as great as 0·05 cm.$^{-1}$, which is somewhat greater than the estimated error in the observations; they may be attributed in part to slight repulsive effects from other levels and similar disturbances of the reference lines, which have not yet been calculated in detail. AUTHORS.

808. Studies on the Raman effect. Rotational isomerism (vinyl-, acetyl- and isopropenyl-, allyl-derivatives). L. KAHOVEC AND K. W. F. KOHLRAUSCH. *Z. phys. Chem. B*, **46**, *pp.* 165–180, *June*, 1940. *In German.*—Comparing newly investigated Raman spectra of vinyl-, acetyl- and isopropenyliodide with older and partly repeated measurements on related substances, the most probable spectra are derived for acetone, allyl alcohol, allyl chloride and bromide. Based on this experimental material the spectra of the derivatives named in the title are analysed and the transitions in the Raman spectra are examined. It is observed that the low rigidity in the chain of the allyl derivatives causes the appearance of at least 2 co-existent modifications in liquid state. R. N.

***809. Studies on the Raman effect. New crystal powder apparatus.** A. W. REITZ. *Z. phys. Chem. B*, **46**, *pp.* 181–193, *June*, 1940. *In German.*—The apparatus previously described [Abstr. 2663 (1937)], now consists of the spectrograph for the main analysis, a pre-analyser which serves for generating monochromatic light, and a post-analyser which prevents the entrance of scattered excitation light into the spectrograph. The crystal powder to be investigated is placed between pre- and post-analyser. The analysers are described and illustrated and some details of the spectrograph are given. R. N.

810. Raman spectrum of 1-bromo-dodecane. F. F. CLEVELAND AND M. J. MURRAY. *J. Chem. Phys.*, **9**, *pp.* 867–868, *Nov.*, 1940.—Raman displacements, estimated intensities and depolarization factors, were measured for 1-bromo-dodecane in the liquid state. The strong, polarized frequencies 563 and 647, characteristic of the $-\ CH_2Br$ group, have the same constant values as other members of the series from *n*-propyl to *n*-heptyl bromide inclusive. The weak, depolarized frequency 3009 is also probably associated with this group. Five of the observed frequencies agree with values of infra-red active chain and end frequencies recently calculated by Whitcomb, Nielsen and Thomas for undecane, the mean deviation being 30 cm^{-1}. The intense, highly polarized frequencies 2 850 and 2 930 and the less intense, depolarized frequency 2 961 appear in the bromide spectrum as well as in the spectra of many other compounds containing alkyl radicals. AUTHORS.

811. Raman spectra of some ethers containing 1 or more phenyl groups. M. J. MURRAY AND F. F. CLEVELAND. *J. Chem. Phys.*, **9**, *pp.* 129–132, *Feb.*, 1941.

812. Raman spectrum of m-diphenyl benzene. S. K. MUKERJI AND S. A. AZIZ. *Phil. Mag.*, **31**, *pp.* 231–239, *March*, 1941.—The spectrum resembles that of *o*-diphenyl benzene and is so highly fluorescent under the total radiation of the mercury arc that no trace of Raman lines appears. But by employing λ4 358 as the exciting line, filtered through a concentrated solution of $NaNO_2$, the continuous background is much cut down and a very fair spectrum obtained, giving 27 lines not recorded before. The most prominent frequency observed is at 1 309 cm.$^{-1}$ and is the characteristic frequency due to the C—C binding of the benzene rings of this compound. This frequency is equally strong in diphenyl and *o*-diphenyl benzene but is not present in benzene. The other strong frequency, at 1 597 cm.$^{-1}$, is due to the benzene nucleus characteristic of the aromatic linking C = C. The third most prominent frequency, at 1 000 cm.$^{-1}$, also occurs prominently in diphenyl [see Abstr. 4555 (1938)] and *o*-diphenyl benzene, but very weakly in benzene. AUTHORS.

See also Abstract 686.

TRANSMISSION.

✱**813. Simple photo-electric turbidimeter.** S. SILVERMAN. *Rev. Sci. Instrum.*, **12**, *pp.* 77–78, *Feb.*, 1941.—The instrument is intended primarily for use with very clear liquids and is suitable for such problems as counting micellar organisms in aqueous solutions, intensity measurements of fluorescent solutions, white blood or bacterial counts. A typical working curve is shown. AUTHOR.

814. Spectrophotometric study of universal indicators. J. T. WOODS WITH M. G. MELLON. *J. Phys. Chem.*, **45**, *pp.* 313–321, *Feb.*, 1941.—Spectral transmission curves were determined for solutions of 15 different mixtures of indicators over the wavelength range 400 to 700 mμ, and at *p*H values covering the whole transformation range of the indicators. Numerical colorimetric characteristics of one mixture are included as representative of this type of mixed indicators. The use of a mixture containing methoxy reds and phthalein indicators is suggested, as well as the use of filter photometers with this type of indicator to determine *p*H values over a fairly wide range. AUTHORS.

VISION.

815. Photographic analysis of some unexplored visual phenomena. W. A. GARDNER. *J. Opt. Soc. Amer.*, **31**, *pp.* 94–98, *Feb.*, 1941.—A photographic investigation was made to discover why, when an observer fixates a stationary point along the line of transit of a rapidly moving automobile, he is apparently able to see the spokes of the rotating wheels. A cylinder marked with four white spots on one end was photographed while rolling down an inclined plane and the experiment was repeated with eight spokes marked on the end, the camera shutter being left open while the cylinder was in motion. The spokes recorded on the plate were shown to be due to the mechanical creation of a cycloidal pattern produced by the component rotation and translation of points on the spokes. The phenomenon was not, therefore, due to any stroboscopic effect, as had been suggested. W. D. W.

816. War time street lighting and aids to movement in street. *Trans. Illum. Engng Soc., Lond.*, **6**, *pp.* 17–22, *Feb.*, 1941.—[Abstr. 585B (1941).]

X-RAYS.

817. Experimental study of the diffuse scattering of X-rays by KCl crystals. S. SIEGEL. *Phys. Rev.*, **59**, *pp.* 371–375, *Feb.* 15, 1941.—Copper radiation was used and observations were made in the immediate region of a strong reflection. The shapes and half-widths of the max. were studied as functions of the direction of incidence. Observations agree with the theory. AUTHOR.

818. Analysis of liquid X-ray diffraction patterns. N. S. GINGRICH. *Phys. Rev.*, **59**, *pp.* 290–292, *Feb.* 1, 1941.—The corrected intensity curve given by Eisenstein and Gingrich for the diffraction of X-rays by liquid A has been subjected to 4 different fittings, one of them including a weak fourth peak, to determine how sensitive the atomic distribution curve is to errors in fitting. An analysis has been made for these 4 cases. The first peak of the atomic distribution curve has about the same shape in each case, the area under this peak varies by less than 10%, and the position of its max. remains constant to within about 1½%. The small secondary peak becomes a plateau by the introduction of a weak fourth peak in the intensity curve. AUTHOR.

819. Radiative transition probabilities in heavy nuclei. E. GUTH. *Phys. Rev.*, **59**, *pp.* 325–331, *Feb.* 15, 1941.—Radiation widths, i.e. emission probabilities from experimental absorption cross-sections for excitation of nuclei by X-rays are deduced. For the lowest activation levels of In^{115} and Pb widths of the order of a few mV are obtained. These widths are of the same order as those of the low levels of the natural radioactive nuclei. The quadrupole radiation widths obtained are within the upper limits set by a sum formula. Formulae for the transition probabilities are given, depending upon both energy and spin. A numerical constant entering into the formulae, which is usually calculated from assumed models, is obtained from experiment. A simple expression is given, valid in the neighbourhood of the short-wave limit, for the intensity of X-rays produced by fast electrons. From this there results an excitation curve with many plateaus, each indicating another nuclear level. These plateaus reveal directly the shape of isochromats, thus providing a qualitative check on the theory of production of X-rays by fast electrons. AUTHOR.

820. Possible Kronig fine structure in X-ray emission spectra. S. T. STEPHENSON. *Phys. Rev.*, **58,** *pp.* 877–878, *Nov.* 15, 1940.—Weak Cu emission bands are observed extending 34 x.u. out on the short-wavelength side of Cu $K\beta_2$. A comparison with Kronig *K*-absorption fine structure for Cu shows that these emission bands are actually caused by absorption of the X-rays while emerging from the Cu target. AUTHOR.

821. *L*-Emission bands of Na, Mg and Al. W. M. CADY AND D. H. TOMBOULIAN. *Phys. Rev.*, **59,** *pp.* 381–385, *Feb.* 15, 1941.—The radiation emitted when conduction electrons fill vacancies in the *L* shell is spread over a band whose shape represents the energy distribution of the conduction electrons. The observed shapes are in general agreement with theoretical predictions and confirm the results of previous experimental studies. In each case a tail is observed at the l.f. end of the band, for which alternative explanations are offered. With the X-ray continuum as a standard of intensity the total intensity of the *L* band increases 19-fold from Na to Al. AUTHORS.

822. Comparison of X-ray absorption fine structure for 2 elements in the same crystal. S. T. STEPHENSON. *Phys. Rev.*, **58,** *pp.* 873–876, *Nov.* 15, 1940.—The fine structures on the short-wavelength side of the *K*-X-ray absorption edges of the elements Cu, Se, Rb, Sr and As, in the compounds RbBr, $SrBr_2$, Cu_2Se, CuBr, ZnSe, AgBr, $CuSeO_4 \cdot 5H_2O$, $CuHAsO_3$ and $Cu(AsO_4)_2 \cdot 4H_2O$, were investigated with a focusing transmission spectrograph. The structures of 2 elements in the same ionic crystal lattice are not identical, and some are different even at energy distances of 150 eV from the main edge. Some factors other than crystal structure alone are shown to influence the fine structure. AUTHOR.

823. X-ray protective values of lead, concrete, barium concrete and steel with tube voltages between 400 and 1 000 kV. R. JAEGER AND A. TROST. *Elektrotech. Z.*, **61,** *pp.* 1025–1029, *Nov.* 14, 1940. *In German.*—While previous authors [Abstr. 4713 (1938)] deduced the protective values for voltages above 400 kV by extrapolation from experimental results obtained below this figure, the present authors extended their experimental work up to 1 000 kV. The measurements were made with ionization chamber and counter. The X-ray tube current was 5 mA at 1 000 kV. The protective values of steel, barium concrete and ordinary concrete, relative to that of lead, increase with increasing penetrative power of the tube and approach values valid for the γ-radiation of Ra. The apparatus used and the procedure of the tests are described in detail and the values obtained are compared with those of previous investigators. A Bibliography is given. R. N.

HEAT.

CALORIMETRY.

824. Specific heats of Cu_3N, NbN, NaN_3 and the atomic heat of N. S. SATOH AND T. SOGABE. *Sci. Pap. Inst. Phys. Chem. Res., Tokyo, No.* 1005, *pp.* 174–182, *Jan.*, 1941.—As Cu_3N and NaN_3 are unstable at high temperatures, the measurements were only carried out over 1 temperature interval: 0°–99·6°C. In the case of NbN the measurements were carried out over 2 temperature intervals: 0°–99·6°C. and 0°–300°C. The atom. ht. of N_2 deduced from the mol. ht. of these N compounds and the atom. hts. of their constituent elements almost agree with the value obtained from solid compounds. AUTHORS.

See also Abstract 836.

CONDUCTION.

825. Determination of Green's function for line sources for the equation of conduction of heat in cylindrical co-ordinates by the Laplace transformation. H. S. CARSLAW AND J. C. JAEGER.

Phil. Mag., **31**, *pp.* 204–208, *March*, 1941.—The Green's function discussed is the temperature at $P(r, \theta)$ at a time t, due to an instantaneous unit line source at $P'(r', \theta')$ at time 0, the solid being then at 0 temperature and the surface kept at 0. J. S. G. T.

DILATATION.

∗826. Interferometric dilatometer with photographic recording. F. C. NIX AND D. MACNAIR. *Rev. Sci. Instrum.*, **12**, *pp.* 66–70, *Feb.*, 1941.

FUSION AND SOLIDIFICATION.

827. Latent heats of fusion of some organic refrigerants. J. H. AWBERY. *Phil. Mag.*, **31**, *pp.* 247–253, *March*, 1941.—The lat. hts. of fusion of methyl chloride, ethyl chloride and dichlorodifluoro-methane show no simple relationships with either the viscosities or the melting points of the substances. AUTHOR.

THERMOCHEMISTRY.

828. Study of sensitized explosions. V. Some new experiments on the hydrogen-oxygen reaction sensitized by NO_2. VI. Experimental observations on the hydrogen-oxygen reaction sensitized by NOCl. VII. A chain-thermal theory of the reaction between hydrogen and oxygen sensitized by NO_2 or NOCl. F. S. DAINTON AND R. G. W. NORRISH. *Proc. Roy. Soc. A*, **177**, *pp.* 393–447, *March* 18, 1941.—The effect of pressure and temperature of reactants, of inert gases, of vessel diameter and of surface condition, on the induction periods and explosion boundary of $2H_2 + O_2$ mixtures containing NO_2 have been determined in the temperature range 350°–410°C. The principal results may be summarized: (*a*) Increase of pressure causes the separation of the upper and lower limiting concentration of sensitizer to increase from zero to a max. value at the inversion pressure. Above this pressure the upper limit decreases and the lower limit increases linearly with increase of pressure. The induction periods of H_2-O_2-NO_2 mixtures of constant NO_2 content decrease rapidly with increase of pressure, approaching a small value asymptotically. (*b*) All foreign gases lengthen the induction periods and eventually quench the ignition of an explosive mixture of H_2-O_2-NO_2 of constant composition. The order of efficiency of the non-reactant gases in lengthening the induction periods is $CO_2 > N_2 > A = He$, whereas the order of efficiency in quenching ignition is $CO_2 > He > N_2 > A$. (*c*) The induction period at the upper limit always exceeds the induction period at the lower limit. The reverse is true of the rates of the slow reactions in the vicinity of the limits. (*d*) At constant total pressure rise of temperature causes the upper limit (P_U) to be raised according to the equation $\log P_U = -E/RT + \text{const.}$ E is 19 500 cal. at a total pressure of 75 mm. and increases with pressure to 25 600 cal. at 472 mm. (*e*) At constant pressure the upper limit decreases and the lower limit increases as the reciprocal of the square of the diameter.—Small amounts of NOCl lower the ignition temperature of $2H_2 + O_2$ mixtures by over 200 deg. C., the efficiency of this substance in this respect being slightly greater than NO_2. At a given temperature the ignition is confined between a lower and an upper concentration of catalyst, outside which only slow reaction occurs. Both the slow reaction and the ignition are preceded by an induction period, the length of which passes from large values through a min. to further large values as the catalyst concentration is increased, and which, in contrast to the H_2-O_2-NO_2 system, is unaffected by irradiation with light from a mercury vapour lamp. The induction periods and limits depend on the pressure and temperature of reactants in a very similar way to the induction periods and limits of the H_2-O_2-NO_2 system described in V. The similarity of the two systems extends to the effect of non-reactant gases in quenching the ignition, the quenching pressures being of the same magnitude in both systems. A difference is, however, found in that these foreign gases shorten the induction period in this system whereas they lengthen it in the H_2-O_2-NO_2 system.—Both these reactions are chain processes for which the net branching factor ϕ is inversely proportional to the induction period. By applying this relation to the experimental results described in V and VI it is shown that ignition only occurs when the net branching factor attains a value determined by the sum of 2 quantities, one proportional to the thermal capacity and the other proportional to the thermal conductivity. It is pointed out that this ignition condition cannot be accounted for by any isothermal theory of ignition, but that it may readily be deduced from a thermal theory in which explosion is visualized as occurring only when the initial reaction rate, in a favourable volume element, is large enough to ensure that a critical temperature T_c is reached in a critical time t_c. Theories of reaction kinetics are developed from these two systems which give ϕ in terms of the experimental variables. The expressions so deduced lead to a dependence of the induction period on these variables identical with that found experimentally. The effects of vessel diameter, surface condition, temperature, and concentrations of sensitizer, reactants and foreign gases, on the explosion are satisfactorily accounted for by substituting these expressions in the ignition condition of the chain-thermal theory. AUTHORS.

829. The molecular heat, lat. ht. of fusion and transition heat of the condensed gases CD_4 and CH_3D. K. CLUSIUS AND L. POPP. *Z. phys. Chem. B*, **46,** *pp.* 63–81, *May*, 1940. *In German.*—As stated previously [Abstr. 782 (1938)], the deuterium methanes CD_4 and CH_3D exhibit 2 transition points at low temperatures while CH_4 exhibits only 1. While the transition I → II is optically indifferent for all 3 gases, the transition II → III—which does not exist for CH_4, probably on account of its high zeropoint energy—leads to a modification showing double refraction. The pressure at the triple point, the m.p., lat. ht. of fusion, temperature and lat. ht. of transition, for the transitions II → I and III → II were measured and tabulated, with values of mol. wt. Apparatus is described for liquefying hydrogen, with which the energy content of comparatively small amounts of condensed gases may be measured for temperatures down to 10°K. The methods of preparation of pure CD_4 and CH_3D are described in detail. The question remains open whether the transitions may be explained by rotational changes in the lattice structure, although some facts seem to point in this direction. R. N.

830. Heat of mixing of chloroform with polyamines. R. W. SPENCE. *J. Phys. Chem.*, **45,** *pp.* 304–309, *Feb.*, 1941.—The heat of mixing of chloroform with cyclohexylamine indicates that equimolar complex formation takes place, owing to the formation of $C - H \leftarrow N$ bonds. The amount of heat liberated is the same as for diethyl ether, but the heat for a polyamine is low compared with that for a polyethylene glycol ether. This difference is explained as due to intermolecular association of the polyamines through $N - H \leftarrow N$ bonds. AUTHOR.

THERMODYNAMICS.

831. Thermodynamics of irreversible processes. III. C. ECKART. *Phys. Rev.*, **58,** *pp.* 919–924, *Nov.* 15, 1940.—The considerations of the first paper of this series [Abstr. 2819 (1940)] are modified so as to be consistent with the special theory of relativity. It is shown that the inertia of energy does not obviate the necessity for assuming the conservation of matter. Matter is to be interpreted as number of molecules and not as inertia. Its velocity vector serves to define local proper-time axes, and the energy momentum tensor is resolved into proper-time and proper-space components. It is shown that the first law of therymodnamics is a scalar equation and not the fourth component of the energy-momentum principle. Temperature and entropy also prove to be scalars. Simple relativistic generalizations of Fourier's law of heat conduction and of the laws of viscosity are obtained from the requirements of the second law. The same considerations lead directly to the accepted relativistic form of Ohm's law. AUTHOR.

832. Thermodynamic treatment of the swelling pressure of coal. W. FUCHS. *J. Franklin Inst.*, **231,** *pp.* 103–119, *Feb.*, 1941.—The pressure developed by a charge of coal undergoing carbonization is considered from the theoretical aspect. Formulae for the swelling pressure are obtained by the application of the 1st and 2nd laws of thermodynamics. A formula is deduced from which conclusions regarding the dependence of the max. swelling pressure on the plastic range, temperature of decomposition, sp. heat, volume and density of the plastic mass, can be drawn. A. J. M.

833. Thermodynamic properties of vapours. E. F. LEIB. *Trans. Amer. Soc. Mech. Engrs*, **63,** *pp.* 157–169; *Disc.*, 169–176, *Feb.*, 1941.—[Abstr. 474B (1941.)]

834. Kinetics of phase change. III. Granulation, phase change and micro-structure. M. AVRAMI. *J. Chem. Phys.*, **9,** *pp.* 177–184, *Feb.*, 1941.—The theory of the preceding papers [Abstr. 1221 (1940)] is generalized and the notation simplified. A cluster of molecules in a stable phase surrounded by an unstable phase is itself unstable until a critical size is reached, though for statistical reasons a distribution of such clusters may exist. Beyond the critical size the cluster tends to grow steadily. The designation nuclei or grains is used according as the clusters are below or above the critical size. AUTHOR.

835. Heat capacity and entropy of AgI and their interpretation in terms of structure. K. S. PITZER. *J. Amer. Chem. Soc.*, **63,** *pp.* 516–518, *Feb.*, 1941.—Experimental measurements of the heat capacity of AgI from 15° to 300°K. are presented. While the extrapolation of the heat capacity below 15°K. is somewhat ambiguous, a fairly reliable entropy value can be obtained which is in agreement with a value obtained from other sources. It is shown that the potential energy for a Ag ion within the surrounding tetrahedron of iodide ions is lowest at the centre of the tetrahedron but that it rises unsymmetrically in different directions. The potential energy rises relatively rapidly in the direction toward one iodide, but only very gradually toward the hole between 3. The smoothness of the heat-capacity curve, however, eliminates the possibility of distinct, separate potential min. within a tetrahedron. It is noted that the increasing colour of silver iodide with rise in temperature may be related to the decreasing average co-ordination number and probably to increasing deviation from pure ionic bond character. AUTHOR.

836. Entropy of formic acid. Heat capacity from 15° to 300°K. Heats of fusion and vaporization. J. W. STOUT AND L. H. FISHER. *J. Chem. Phys.*, **9**, *pp.* 163–168, *Feb.*, 1941.—The heat capacity of solid and liquid formic acid has been measured from 15° to 300°K. From the third law of thermodynamics and the calorimetric data the entropy has been calculated. To the value obtained from the calorimetric measurements an entropy of $R/2\log_e 2$, due to the random orientation of H-bonds in the solid, has been added. AUTHORS.

837. Gas imperfection. Thermodynamic quantities for some unsaturated aliphatic hydrocarbons derived from the equations of state. E. E. ROPER. *J. Phys. Chem.*, **45**, *pp.* 321–328, *Feb.*, 1941.—With the aid of previously developed temperature-coefficient equations [*J. Phys. Chem.*, **44**, *pp.* 835–846, *Oct.*, 1940] for the second virials of 7 hydrocarbons, various thermodynamic quantities are calculated, i.e. the second virials, the actual molal volumes, the temperature coefficients of the volume, and 2 differences in the heat capacities. Utilizing previously determined vapour-pressure equations in conjunction with the l.p. data of state, the second virials, the actual molal volumes, the fugacities, the actual heats and entropies of vaporization, and the gas-imperfection corrections to the heats of vaporization and to the absolute entropies, are calculated for the 7 hydrocarbons at their respective normal b.p. A discussion of the correlation of the gas-imperfection effects with other molecular quantities is given, and it is shown that the numerical magnitude of the normal b.p. may, to a certain extent, serve as an index to the imperfections. AUTHOR.

838. Interrelationships between fluidity, volume, pressure and temperature in liquids. E. C. BINGHAM, H. E. ADAMS AND G. R. MCCAUSLIN. *J. Amer. Chem. Soc.*, **63**, *pp.* 466–474, *Feb.*, 1941.—From an examination of data for 11 organic liquids at 30° and 75° and 1–12 000 atm. an equation is found for the fluidity/volume curves of the aliphatic alcohols. To lower the fluidity a given amount requires a different reduction in the volume depending on whether it is effected by pressure or cooling, the difference being explained as due to the high elasticity of the atoms and molecules. The min. molecular volume for zero fluidity is independent of the temperature of the liquid and may be calculated from atomic constants. When Hg is heated the volume varies as $t + 272{\cdot}8°$. The fluidity of Hg varies linearly with the molar volume either $[V]_P$ or $[V]_T$. On subtracting from either the corresponding limiting volume, the free volumes for isobar $[F]_P$ and isotherm $[F]_T$ are obtained. The fluidities $[\phi]_P$ and $[\phi]_T$ are directly proportional to these free volumes. For Hg under pressure the reciprocal of the molar free volume is directly proportional to $P_{atm} + 39\,780$. Combining these laws gives $[(P + 39\,780)/(t + 272{\cdot}8)]\, F = R_L = 0{\cdot}1069$ litre-atm. Hence the fluidity of Hg at any temperature and pressure may be calculated. N. M. B.

839. The derivation of the concept "liquid with fixed structure" from analysis of the thermodynamic function for normal and highly polymerized liquids. K. UEBERREITER. *Z. phys. Chem. B*, **46**, *pp.* 157–164, *June*, 1940. *In German.*—[See Abstr. 2668 (1940)]. By separating the components of energy and entropy in the thermodynamic function of a normal and a highly polymerized liquid the author explains the effect of the length of the molecular chain on the freezing sphere and the influence of the freezing phenomena upon volume. The f.p. is raised by the higher mobility of the end links, but with increasing length of the chain the influence of the end links diminishes and the f.p. becomes less dependent on the increasing mol. wt. The bend in the volume/temperature curve at the freezing sphere is explained. The f.p. is shown to be the point of intersection of 2 straight lines giving the coefficients of expansion above and below the freezing sphere, respectively. R. N.

840. Dissociation treatment of condensing systems. IV. C. CH'ENG, T. P. TSENG, S. K. FENG AND W. BAND. *J. Chem. Phys.*, **9**, *pp.* 123–128, *Feb.*, 1941.—[See Abstr. 818 (1940).] The dissociation theory is applied to 18 different gases and vapours, ranging in mol. wt. from H_2 to Xe. Interaction energies per molecule in clusters formed during condensation of the saturated vapours are found as functions of temperature. From the differences between surface energy and measured surface tension, which remain finite at T_c, estimates are made of the numbers of heavy clusters maintained in the saturated vapour over the liquid surface, also as functions of temperature. In the case of 8 vapours the theory predicts measurable differences between the two critical points, T_c, at which the meniscus blurs, and T_γ, at which the densities equalize, the largest differences being for water, 6·5 deg. K., methyl alcohol, 5·1 deg. K., and nitrous oxide, 4·1 deg. K. True critical volumes at T_γ are calculated. AUTHORS.

ACOUSTICS.

841. Analysis of pulses by means of harmonic analyser. R. S. SHANKLAND. *J. Acoust. Soc. Amer.*, **12,** *pp.* 383–386, *Jan.*, 1941.—An important group of non-periodic phenomena, including the transmission of acoustic pulses in air and solid materials, the passage of pulses through amplifiers, etc., requires the evaluation of the Fourier integral to give the complete spectrum, both amplitudes and phases, of the components making up the pulse. Such problems can be solved directly and with ease by charting the pulse to several scales of abscissae and analysing the graphs with the Henrici analyser, which is capable of giving 30 components. The detail in the resulting analysis depends simply on the number of curves drawn to different scales which are traced. The method is also of general use in other problems where the Fourier integral appears, including the analysis of radiation pulses, X-ray and electron diffraction patterns, and the flow of heat. AUTHOR.

842. Elastic-wave filtration in non-homogeneous media. R. B. LINDSAY. *J. Acoust. Soc. Amer.*, **12,** *pp.* 378–382, *Jan.*, 1941.—Previous work has indicated that when harmonic compressional waves pass through a stratified medium consisting of a series of alternating layers of 2 different substances, which may be either fluid or solid, the medium acts as an acoustic filter with alternate transmission and attenuation frequency bands. This analysis of the transmission characteristics of the medium was based on the assumption that the transition in acoustical properties (i.e. density and sound velocity) from each layer to the next is abrupt and effectively discontinuous. The purpose of the present investigation is to examine the consequences of assuming that the transition in question is a gradual one. The interesting theoretical result is that for a gradual transition in which there are no discontinuous changes in either the acoustical properties or their gradients the stratified medium passes all frequencies. In order to assure attenuation for a gradual transition one must assume at least discontinuity in the gradients of the acoustical parameters.

AUTHOR.

843. Excitation of intra-molecular vibrations in gases and gas mixtures. VI. Sound-absorption and dispersion measurements on CH_4, COS and their mixtures with other gases. A. EUCKEN AND S. AYBAR. **VII. Theory of sound dispersion in the presence of several normal vibrations.** K. SCHÄFER. *Z. phys. Chem. B*, **46,** *pp.* 195–228, *June*, 1940. *In German.*—The average time required for the exchange of translational and vibrational energy is investigated between 20° and 400°C. by the method of sound absorption and dispersion. Confirming results of previous investigations with other gases [Abstr. 5013 (1938)] there is no indication of different relaxation times for the single vibrations, a uniform period of adjustment holds for the total heat of vibration, and the additional gases are the more effective the easier they react with the main gas. A higher percentage of additional gas was investigated. A corrected formula for determining the average relaxation time is given. The inert gases are generally more effective than the main gas although less so than chemically active gases.—Previous theories of sound dispersion [Abstr. 1972 (1933)] were based on the presence of only one normal vibration. The author investigates the case of several vibrations excited simultaneously. Similar dispersion curves are obtained as in the case of only one normal vibration. From the slight deviation of the experimental dispersion curves from standard type the ratio of the relaxation times for single normal vibrations may be determined. The necessary equations are derived and an example of the application of the theory is given. The theory provides an explanation of the anomalous temperature coefficients of the relaxation times different from that of other investigators [Abstr. 957 (1939)]. R. N.

844. End corrections of organ pipes. A. T. JONES. *J. Acoust. Soc. Amer.*, **12,** *pp.* 387–394, *Jan.*, 1941.—This is an experimental study of the end corrections of 2 rectangular wooden pipes, each wide open at one end and partly closed in various ways at the other. The pipe was excited by a telephone receiver set into one side of the pipe, and the sound was picked up through a small-bore brass listening-tube screwed into another side of the pipe and connected by rubber tubing to the observer's ear. The receiver was fed from an a.f. oscillator, the frequency of which was varied to obtain the max. resonant response. Equations for the frequency of a partly closed pipe have been suggested by several investigators. The present experiments show that not more than 1 of these equations is satisfactory for any extended range of apertures. Attention is drawn to the restriction which a wall near an opening imposes on the flow of air through the opening and the consequent effect on the natural frequency of an adjacent cavity. The fundamental resonant frequency of an organ pipe may be either above or below the frequency obtained by blowing.

AUTHOR.

845. Sound velocities in gases under different pressures. R. C. COLWELL AND L. H. GIBSON.

J. Acoust. Soc. Amer., **12,** *pp.* 436–437, *Jan.*, 1941.—With a rapid succession of sound pulses and an oscilloscope it is possible to measure the velocity of sound over short distances. A gas-tight metal container has within it a loud-speaker and movable microphone. The pulses sent out by the loud-speaker are received by the microphone and translated into a sine wave on the oscillograph. Measurements were made upon air, N and CO_2 at different pressures. The velocity did not vary with the pressure. AUTHORS.

846. Influence of certain atmospheric conditions upon sound transmission at short ranges. H. V. EAGLESON. *J. Acoust. Soc. Amer.*, **12,** *pp.* 427–435, *Jan.*, 1941.—A formula is derived giving sound intensity as a function of temperature, humidity and barometric pressure. A series of measurements was made of the intensity of sound from constant sources at short fixed distances. Readings were taken in all the sorts of weather that can be found in Indiana. In general the experimental values agree with those calculated from the formula to within 5%. AUTHOR.

847. Ultrasonic absorption and velocity measurements in liquids. G. W. WILLARD. *J. Acoust. Soc. Amer.*, **12,** *pp.* 438–448, *Jan.*, 1941.—By means of ultrasonic light-diffraction phenomena the velocity and absorption of sound in some 40 transparent liquids were measured in the frequency range 6 to 30 Mc./s. Velocity values were obtained from measurements of the diffraction spectra spacing. Absorption values were obtained by measurement of the sound radiator voltages required to produce certain colour transmission effects at measured distances from the sound radiator. The relation between sound-beam width (in the optical direction) and light transmission was studied. In general, the values of velocity obtained were found to be independent of frequency, and the absorption to be proportional to $(\text{frequency})^2$ and unrelated to calculated viscous and thermal losses. A simple calculation is proposed for estimating absorption errors caused by sound-beam diffraction and spreading. AUTHOR.

848. Space attenuation of impact sounds in a brick building. A. E. KNOWLER. *Phil. Mag.*, **31,** *pp.* 240–246, *March*, 1941.—A study of impact noises on concrete floors leads to the following conclusions: (1) The relation between the equivalent loudness heard in a room and the distance of the room from the source of the impact noise is roughly linear. (2) The space rate of attenuation of the loudness of dull blows is substantially more than that of sharp ones, the mean values for a concrete floor or for uninterrupted brickwork being about 0·3 phon/ft. for the type of sharp blows used and about 0·5 phon/ft. for the full blows. (3) For the same type of blow the space rate of attenuation down a longitudinal wall interrupted by windows may be 50% greater than that down an equally heavy unbroken transverse wall. AUTHOR.

849. Sound-prevention mechanism of non-porous materials. II. S. KAWASHIMA. *J. Acoust. Soc. Amer.*, **12,** *pp.* 327–331, *Jan.*, 1941.—[See Abstr. 3004 (1940)]. The problem of sound prevention from the architectural standpoint was experimentally investigated and agreement with the theory checked. The formulae of Davis for the transmission loss in plate-like materials and in thin flexible materials were verified experimentally. Formulae are derived giving the transmission loss, and the max. value of the transmission loss, for an elastically built-in wall of which the thickness is comparable with the exciting wavelength. AUTHOR.

850. Noise tremor due to traffic. R. K. BERNHARD. *J. Acoust. Soc. Amer.*, **12,** *pp.* 338–347, *Jan.*, 1941.—This paper presents a study on noise and mechanical vibration abatement with respect to the field of structural engineering. Certain units of noise tremor are defined and some psychological and physiological concepts outlined (sensation thresholds and bearable limits for the human body). Fundamental principles of the measuring instruments are given. In reporting the investigations in buildings and in the field, particular attention is given to the influence of speed of vehicles, super- and sub-structure of roadbeds, operation and construction methods and the damping capacities of soils. The combined effect of noise and mechanical vibrations is studied. AUTHOR.

851. Tone guard. H. F. OLSON. *J. Acoust. Soc. Amer.*, **12,** *pp.* 374–377, *Jan.*, 1941.—An acoustic network has been developed for attenuating the sound, generated and radiated directly into the air by the vibrating parts of the phonograph pick-up, which passes through the aperture between the door and the cabinet. The series elements are formed by the slit between the door and the cabinet. The shunt elements are formed by a wood strip fastened to the inside of the cabinet. The attenuation band extends from 1000 to 10000 c./s. The attenuation is of the order of 15 db greater than that with the conventional door and cabinet. AUTHOR.

852. Theory of tracing distortion in sound reproduction from phonograph records. W. D. LEWIS AND F. V. HUNT. *J. Acoust. Soc. Amer.*, **12,** *pp.* 348–365, *Jan.*, 1941.—General formulae are derived, as an expansion in powers of the amplitude and its derivatives, for the motion of a stylus of any shape sliding on the warped groove surfaces representing any arbitrary recorded signal. These formulae provide simple expressions for the second- and third-order harmonic distortion of pure tones and are also applicable for the computation of cross-modulation products for two- or many-tone signals, including a continuous recorded spectrum. Typical computations for these cases are presented and a general criterion is established for the max. r.m.s. distortion for an arbitrary steady-state signal. The computations provide a basis for discussing the advantages of lateral-cut over vertical-cut, the effect on distortion of pre-emphasizing the recorded spectrum, and the efficacy of re-recording techniques. AUTHORS.

ELECTRICITY AND MAGNETISM.

CONDUCTION IN SOLIDS AND LIQUIDS.

853. Directional dependence of electrical conductivity. E. M. BAROODY. *Phys. Rev.*, **58**, *pp.* 793–804, *Nov.* 1, 1940.—The author reviews the usual theory, developing the basic equations in the somewhat generalized form necessary for the problem, and discusses the nature of the electron-lattice interaction in some detail. The directional dependence is calculated for several simple models. AUTHOR.

***854. New ionization amplifier.** H. LE CAINE AND J. H. WAGHORNE. *Canad. J. Res. A*, **19**, *pp.* 21–26, *Feb.*, 1941.—A new type of instrument for measuring ionization currents is described. Whenever a charge is placed upon the electrode of the ionization chamber, an alternating voltage is obtained by electrostatic translation of the motion of a reed. The alternating voltage is amplified in an amplifier containing only standard radio parts and used to measure the ionization current by a condenser balance method. An instrument tested in the laboratory measured a quantity of $1{\cdot}5 \times 10^{-12}$ coulombs with about the same accuracy as a DuBridge and Brown instrument. The readings were recorded automatically and could be taken as rapidly as every 3 secs. with no linearity correction. AUTHORS.

DIELECTRICS AND CAPACITANCE.

855. Local field in polarized dielectrics. G. JAFFÉ. *J. Chem. Phys.*, **8**, *pp.* 879–888, *Nov.*, 1940.—A new deduction for the Lorentz force is given by considering such molecules as have their nearest neighbour at a given distance, summing over all dipoles in the field, and finally averaging. The same procedure is applied to the case in which correlations between each molecule and its immediate neighbourhood are assumed to exist according to Onsager's theory. The method leads to an extension of Onsager's results to the case of media of variable density, including gases. The distribution law of the local field is deduced for dipoles of constant moment μ_0 with the aid of a probability theorem of Markoff-Gans. Both under Lorentz's and under Onsager's assumptions the local field becomes isotropic, to a first approximation, for weak external fields. Its average value is more than twice the max. value of the Lorentz force obtainable with a given dipole density. The calculated deviations from the Clausius-Mosotti and Lorentz-Lorenz expressions are compared with experimental evidence. AUTHOR.

856. Dielectric polarization in solution. W. H. RODEBUSH, C. R. EDDY AND L. D. EUBANK. *J. Chem. Phys.*, **8**, *pp.* 889–896, *Nov.*, 1940.—Curves showing the apparent molal polarization as calculated by the Debye-Clausius-Mosotti procedure are compared with the molal polarizability calculated as previously proposed [Abstr. 2235 (1940)]. It is possible to give a satisfactory explanation of the latter curves in terms of association, whereas the former curves show a behaviour so complex that it is difficult to interpret. AUTHORS.

857. Intensities of r.f. spectra. H. C. TORREY. *Phys. Rev.*, **59**, *pp.* 293–299, *Feb.* 1, 1941.—In order to compare theoretical and observed line shapes of r.f. spectra, the inhomogeneity in velocity of the beam molecules must be taken into account. The theoretical expression for line shape is integrated over the velocity distribution in the beam, and the result is expressed in terms of integrals. The important parameters in the theory of line shapes are the matrix elements of the interaction with the radiation field. These are evaluated in the case of atoms with electronic angular momentum $J = \frac{1}{2}\hbar$ and arbitrary nuclear spin. AUTHOR.

858. Contribution to the theory of anomalous dispersion and dielectric loss of solids. W. HOLZMÜLLER. *Phys. Z.*, **41**, *pp.* 499–508, *Nov.* 15, 1940. *In German.*—The investigations refer mainly to highly polymerized polar organic substances. The dielectric loss is explained as being dependent on the changes taking place when balance is restored between the polar groups of the molecule after potential troughs, i.e. the min. of potential energy, have been surpassed. The number of dipole moments in states of higher potential energy is greater when an electric field is applied. The new dipole moment after an energy threshold has been passed is formed by the common action of strong heat impacts and the electric field. By introducing one or more relaxation times the author explains the observed dependence of permittivity and loss angle on frequency and temperature. Measured values of permittivity and loss angle permit of calculating the quantities important for the determination of the forces active inside the molecule. R. N.

ELECTROCHEMISTRY.

859. Thermodynamics of bi-univalent electrolytes. VI. Solutions of CdI$_2$ from 5° to 40°C. R. G. BATES. *J. Amer. Chem. Soc.*, **63**, *pp.* 399–404, *Feb.*, 1941.—E.M.F. measurements of the cell Cd–Hg (2-phase) | CdI$_2$ (*m*) | AgI–Ag have been made at intervals of 5 deg. C. over the range of temperature 5° to 40°C. The molality of CdI$_2$ was varied from 0·002 to 2. The standard potential of the cell was evaluated. The stoichiometrical activity coefficients, the relative partial molal heat content and the relative partial molal specific heat of CdI$_2$ in aqueous solution, have been calculated. Comparisons with CdCl$_2$ and CdBr$_2$ were made. AUTHOR.

860. Tungsten-nickel and tungsten-silver electrode systems in neutralizations. H. G. DIETRICH AND P. J. BENDER. *Industr. Engng Chem.* (*Analytical Edition*), **13**, *pp.* 105–107, *Feb.* 15, 1941.—The W-Ni electrode system is not found satistisfactory in neutralizations involving dilute solutions. The W-Ag system appears to furnish precise and accurate electrical end points in titrations of strong acids by strong bases as dilute as 0·001 *N*, and vice versa for 0·01 *N* solutions. In titrations employing more concentrated solutions the system is of value in the neutralization of strong acids by ammonium hydroxide, of acetic acid by a strong base, and of sodium carbonate. AUTHORS.

861. Polarographic determination of nickel and cobalt. J. J. LINGANE AND H. KERLINGER. *Industr. Engng Chem.* (*Analytical Edition*), **13**, *pp.* 77–80, *Feb.* 15, 1941.—In supporting electrolytes containing pyridine or thiocyanate the half-wave potential of Ni is 0·3 V more positive than that of Co, and the excellent separation of the two waves permits the simultaneous determination of both metals. The use of a supporting electrolyte containing pyridine is preferable to one containing thiocyanate, because with the latter the diffusion current of Co shows peculiar irregularities, especially in acid solutions or in the presence of ammonium salts. A sharp separation of ferric iron from small amounts of Ni, Co and Cu by precipitation as hydrous ferric oxide is obtained with a supporting electrolyte of *p*H equal to about 5·4 containing equal concentrations of pyridine and pyridinium salt. Ni and Co are not co-precipitated with the hydrous ferric oxide under these conditions, and the method is well suited to the simultaneous determination of Ni and Co in steel. Moderate amounts of Cr in steel are completely co-precipitated with the hydrous ferric oxide and hence do not interfere with the determination of Ni and Co. Mn and small amounts of Cu do not interfere. AUTHORS.

862. Dissociation constants of the methylammonium ions and the basic strengths of the methylamines in water. D. H. EVERETT AND W. F. K. WYNNE-JONES. *Proc. Roy. Soc. A*, **177**, *pp.* 499–516, *March* 18, 1941.—The dissociation constants of the 3 substituted methylammonium ions have been determined in water at 10 deg. intervals from 0 to 50°C. From these results values have been derived and tabulated for the free energies of dissociation, heats of dissociation, entropies of dissociation and the heat capacity changes for these ions, as well as the corresponding quantities for the ionization of the amines. The heat capacity changes are discussed and it is shown that they cannot be interpreted by simple electrostatic theory. It is shown that the anomalous order of the basic strengths of the amines probably disappears at low temperatures. AUTHORS.

863. Fourth ionization constant of ferrocyanic acid. O. E. LANFORD AND S. J. KIEHL. *J. Phys. Chem.*, **45**, *pp.* 300–304, *Feb.*, 1941.—The constant was determined by direct measurement of the *p*H of Fe(CN)$_2$-HCl solutions. Its value is $6{\cdot}8 \times 10^{-5}$. AUTHORS.

864. Electrochemistry of non-aqueous solutions. Precision measurements of freezing point and conductivity in formic acid. J. LANGE. *Z. phys. Chem. A*, **187**, *pp.* 27–42, *July*, 1940. *In German.*—Ideal electrolytes are characterized by the property that only electrostatic forces are active between the ions. Their osmotic behaviour has been theoretically represented by Debye and Hückel. The present investigations show that solutions of KCl, N(CH$_3$)$_4$Cl, potassium picrate and methylene blue chloride in formic acid behave in most respects like ideal electrolytes if the finite size of the ions is taken into account. The analogy between the mathematical expressions for the osmotic coefficient and the conductivity coefficient, with regard to dependence on concentration, exists for formic acid solutions as well as for aqueous solutions. The dissociation constant of formic acid is 2×10^{-8}. With the two last named salts solvolysis takes place. The higher the affinity of the salt to the solvent the more nearly the behaviour of the solution resembles that of an ideal electrolyte, as is especially shown in the case of $N(CH_3)_4Cl$. The permittivity of the solvent plays only a secondary part in this case. R. N.

865. Properties of detergent solutions. XI. Electrophoretic mobilities in dodecyl pyridinium iodide solutions. J. POWNEY AND L. J. WOOD. *Trans. Faraday Soc.*, **37**, *pp.* 220–223, *April*, 1941. —[See Abstr. 305 (1940).] Measurements of the electrophoretic mobility of dispersions of nujol, ilmenite and glass in solutions of the cation-active salt, dodecyl pyridinium iodide, are described. The effect of added electrolytes on the mobility has also been investigated. In very dilute solutions the behaviour of oil drops is markedly different from that of solid particles such as ilmenite and glass. AUTHORS.

866. Ionic mobilities in insulating liquids. A. GEMANT. *Phys. Rev.*, **58**, *pp.* 904–908, *Nov.* 15, 1940.—A simple method is suggested which allows ionic mobilities in insulating liquids to be computed from conductivity/time curves obtained after application of a d.c. potential. The ionic radii and the concentration of the corresponding particles can be computed from the mobilities obtained. The method is applied to some data of Whitehead, and ionic mobilities of the order 10^{-7} cm./sec./V/cm. are obtained. AUTHOR.

867. Velocity of migration of protons in the electric field in the α phase of the system Pd-H. E. WAGNER AND G. HELLER. *Z. phys. Chem. B*, **46**, *pp.* 242–249, *June*, 1940. *In German.*—The transport number of H in Pd was determined and found to be $0{\cdot}79 \times 10^{-6}$ at 182° and $1{\cdot}19 \times 10^{-6}$ at 240°C. The measurements were made with the α phase of the system Pd-H in which only a small percentage of H is solved in Pd [Abstr. 2377 (1935)]. From these values the velocities of proton migration are found to be $1{\cdot}46 \times 10^{-4}$ and $2{\cdot}80 \times 10^{-4}$ $cm^2.\ V^{-1}\ sec.^{-1}$, respectively. These figures are only about 0·4 to 0·55 of the values determined from the diffusion velocity. The difference may be qualitatively explained by the screening of the proton charge by electron clouds and by electrophoresis. The apparatus used for the experiments comprises a capillary containing the Pd wire partly melted into glass. After evacuation the necessary amount of H is admitted. After closing the admission pipes the wire is heated to the desired temperature and electric current is sent through the wire. The speed of movement of a drop of α bromonaphthalene contained in a capillary communicating at both ends with the one containing the wire is determined and in combination with the current allows of computing the transport numbers. R. N.

868. Studies in hydrogen overvoltage at high current densities. II. The influence of the solvent. A. HICKLING AND F. W. SALT. *Trans. Faraday Soc.*, **37**, *pp.* 224–231, *April*, 1941.—Hydrogen overvoltage measurements have been made in the current density range 10^{-3} to 1 $A/cm.^2$ for Hg, W, platinized Pt, Sn and Pb electrodes in *N*-HCl solutions in ethylene glycol; supplementary observations have been carried out in ethyl alcohol and cyclohexanol. In no case is the hydrogen overvoltage less in the alcoholic solvents than in water, and in general the shapes, slopes and positions, of the overvoltage/log C.D. graphs are not substantially different from those in aqueous solution. It is concluded that the environment of the H ion is not a primary factor conditioning hydrogen overvoltage, although the nature of the solvent may cause minor variations due to secondary influences. AUTHORS.

See also Abstract 682.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

869. Specific charge of the positron. A. H. SPEES AND C. T. ZAHN. *Phys. Rev.*, **58**, *pp.* 861–864, *Nov.* 15, 1940.—The investigation extends previous measurements of the specific charge of β-particles by making a direct comparison between electrons and positrons. The positrons and electrons were obtained from artificially radioactive copper. Comparisons were made for β-particles having approximately the velocity $\beta = 0{\cdot}72$. The results indicate that the ratio e/m_0 for positrons is the same as for electrons to within approximately 2%. AUTHORS.

870. Theory of resonance scattering of protons and neutrons on He. F. BLOCH. *Phys. Rev.*, **58**, *pp.* 829–836, *Nov.* 1, 1940.—A treatment of the general dispersion problem is presented in which the wave function describing a resonance process appears as a monochromatic Fourier component of a wave packet, which is built in such a way that, for $t > 0$, it represents the decay of a compound state and, for $t < 0$, the building-up of the same compound state. The method is applied to the resonance *P* scattering of protons and neutrons on He. AUTHOR.

871. Calculation of force fields from scattering. F. C. HOYT AND W. E. FRYE. *Phys. Rev.*, **58**, *pp.* 784–786, *Nov.* 1, 1940.—A method is developed for calculating the field which gives an observed scattering under the assumption that the interaction can be represented by a central field and that the phase shifts can be calculated by the

W.K.B. approximation. Application to electronic and nuclear scattering is discussed.

Authors.

872. Anomalous scattering of neutrons by He. II. H. Staub and H. Tatel. *Phys. Rev.*, **58,** *pp.* 820–828, *Nov.* 1, 1940.—The anomalous scattering of neutrons by He at neutron energies of about 1 eMV [see Abstr. 1373 (1939)] has been investigated more closely. The backward-scattering cross-section shows a peak of 0·4 eMV half-width and indicates a doublet structure with a splitting of about 0·3 eMV. The absolute value of the ratio of the scattering cross-sections of He and H at 2·5 eMV neutron energy was redetermined and found to be considerably smaller than the value given in a previous investigation. This lowers the absolute values of the resonance scattering cross-section given previously. The new values, however, are still consistent with the assumption that the resonance level is a *P* level. The measures are found to be in agreement with the dispersion theory. The present experiments do not fix the sign of the splitting, although there is some indication that the doublet is normal.

Authors.

873. Elastic scattering in He at 15°C. R. L. Mooney. *Phys. Rev.*, **58,** *pp.* 871–873, *Nov.* 15, 1940.—An angular distribution function is obtained for the scattered intensity of head-on collisions of parallel beams of He atoms with relative velocities appropriate to a temperature of 15°C. Margenau's interaction energy is used in a form modified for small values of the separation parameter. The scattering curve does not exhibit the striking regularity obtained in calculations based on the smooth sphere model. The expected max. at 90° is present. The total collision cross-section is calculated. The diffraction cross-section is compared with the viscosity cross-section.

Author.

874. Capture cross-sections for thermal-energy neutrons. II. F. Rasetti. *Phys. Rev.*, **58,** *pp.* 869–870, *Nov.* 15, 1940.—Cross-sections for capture of slow neutrons by a number of elements were measured by determining the intensity of the β-activity induced under standard neutron irradiation. The number of neutrons was measured by using as standard the activity induced in Mn, the cross-section for capture by Mn being taken from former experiments. Data are reported for neutron capture by Na^{23}, Al^{27}, P^{31}, K^{41}, V^{51}, Cu^{63}, Cu^{65}, As^{75}, Br^{79}, Sb^{121}, I^{127}. [See Abstr. 3202 (1940).]

Author.

875. Capture cross-sections for slow neutrons. K. Sinma and F. Yamasaki. *Sci. Pap. Inst. Phys. Chem. Res. Tokyo, No.* 1004, *pp.* 167–173, *Jan.*, 1941.—The relative capture cross-sections for slow neutrons are determined for about 50 isotopes by measuring the intensity of β-rays from induced radioactive isotopes produced by neutron capture. Absolute cross-sections are calculated by employing the data on the absorption measurements of Dunning, Pegram, Fink and Mitchell.

Authors.

876. Products of ionization by electron impact in methyl and ethyl alcohol. C. S. Cummings and W. Bleakney. *Phys. Rev.*, **58,** *pp.* 787–792, *Nov.* 1, 1940.—Observations were made of 14 different ions in methyl alcohol and 25 in ethyl alcohol. The appearance potentials of many of these were measured and the manner of dissociation in several cases was established. In all cases subject to unambiguous interpretation that reaction occurred which required the least dissociation energy. The concept of localized charge on the oxygen atom in certain complex ions is supported by the results.

Authors.

877. Ionization and dissociation of diatomic molecules by electron impact. H. D. Hagstrum and J. T. Tate. *Phys. Rev.*, **59,** *pp.* 354–370, *Feb.* 15, 1941.—The authors describe an extension of the mass spectrometric method of study of ionization and dissociation processes occurring in diatomic molecules under electron impact and give the results of further investigation of the molecules H_2, CO, NO, N_2 and O_2. The shapes of the peaks in the graph of resolved ion current as a function of ion accelerating potential are analysed and accounted for in terms of the wave-mechanical theory of the diatomic molecule and the characteristics of the mass spectrometer. The study of the peak shape, coupled with appearance potential measurements, has led to conclusions concerning the nature of the dissociation process and the structure of the molecule.

Authors.

878. Negative-ion formation in I_2 vapour by electron impacts. R. Buchdahl. *J. Chem. Phys.*, **9,** *pp.* 146–152, *Feb.*, 1941.—The negative-ion formation was investigated as a function of electron velocity (0–7 eV). The following reaction is characteristic at these velocities: $I_2+e\rightarrow I^-+I$. Measurements of the kinetic energy of the ions for different electron energies show that all the ions are formed by the same reaction. The variation of the yield as a function of the velocity of the electrons can be understood with the help of a potential-curve diagram, by considering transitions from the ground state of the I_2 molecule to the ground state of of the I_2^- molecule. The probability that an electron colliding with an I_2 molecule forms a negative ion varies between 10^{-4} and 10^{-3}. With the aid of an energy cycle the electron affinity of the iodine atom can be calculated, if the dissociation energy of the neutral molecule, the kinetic energy of the incoming electron and the kinetic energy of the ions, are known. The value of the electron affinity obtained by this method is 3·0 ± 0·2 eV, which is in agreement with other determinations. AUTHOR.

879. Scattering of fast electrons by heavy elements. J. H. BARTLETT, JR. AND T. A. WELTON. *Phys. Rev.*, **59**, *pp.* 281–290, *Feb.* 1, 1941.—If fast electrons impinge on a Hg atom, the external electrons will modify the nuclear scattering, at least for small angles. The authors have determined the amount of scattering to be expected, as a function of angle, for 100 kV electrons and for 230 kV electrons. Shielding is effective for the former below 60° and for the latter below 15°. For the determination of phase shifts the electron may be pictured as moving in an effective (Dirac) field which involves zero, first and second derivatives of the ordinary (Hartree) field. Three methods were used: (1) integration with the differential analyser, (2) the WKB procedure, and (3) the first-order Born approximation. Methods (1) and (2) lead to results in good agreement with each other for all angular momenta, and method (3) gives good results for large angular momenta, despite the fact that the first-order correction to the wave function is large. The summation of the series for the scattering amplitudes was accomplished by noting that the phase shifts decreased in an exponential manner for large values of the angular momentum. AUTHORS.

880. Protons from the deuteron bombardment of the separated isotopes of Cl. E. F. SHRADER AND E. POLLARD. *Phys. Rev.*, **59**, *pp.* 277–280, *Feb.* 1, 1941.—The bombardment of Cl by 3·2 eMV deuterons is found to give rise to several groups of protons and possibly to 1 group of α-particles. By bombarding targets in which the proportion of heavy Cl was more than doubled an assignment of some of the groups has been possible. The assignment of *Q* values is as follows. Cl^{35}(*dp*)Cl^{36}: 6·31; 5·35; and 1·50 eMV Cl^{37}(*dp*)Cl^{38}: 4·02; 3·02; 2·10. These figures lead to masses of 35·9808 and 37·9806 for the isotopic masses of Cl^{36} and Cl^{38}, respectively. A group which appears at 12 cm. range is assigned to the light isotope according to the reaction Cl^{35}($d\alpha$)S^{33}. The *Q* value is 9·1 eMV which gives a mass of 32·9828 for S^{33}, in reasonable agreement with the mass derived from the S^{32}(*dp*)S^{33} reaction. AUTHORS.

881. Precise determination of energy of neutrons from deuteron-deuterium reaction. T. W. BONNER. *Phys. Rev.*, **59**, *pp.* 237–240, *Feb.* 1, 1941.—The energy of the neutrons emitted in the forward direction to the 0·52 eMV deuterons which produced the disintegrations was found to be 3·58 ± 0·03 eMV. The disintegration *Q* value of the reaction is 3·31 ± 0·03 eMV. The mass of He^{3} calculated from this *Q* value is 3·01698 ± 0·00006 mass units. AUTHOR.

882. Scattering of mesotrons in tungsten. F. L. CODE. *Phys. Rev.*, **59**, *pp.* 229–232, *Feb.* 1, 1941.—Measurements of the scattering of mesotrons have been made with a 30 cm. counter-controlled cloud chamber in a 12·900-oersted magnetic field. The scattering block consisted of 3·8 cm. of W, and the lowest Geiger-Müller counter was mounted directly over the centre of the W. Scattering-angle and curvature measurements were made on 359 tracks. In addition there were 92 high-energy tracks with a deflection too small to be measurable. The scattering angles varied from 0 to 18·7°, and the mean energies *E* were nearly all less than 2 × 10^{9} eV. The values of the product $E\theta$ varied from zero to a max. of 13·7 × 10^{9} eV degrees. The results support Williams's assumption that the main force responsible for the Gaussian part of the scattering is that arising from the electric charges of the mesotron and of the nucleus. AUTHOR.

883. Variation of rate of decay of mesotrons with momentum. B. ROSSI AND D. B. HALL. *Phys. Rev.*, **59**, *pp.* 223–228, *Feb.* 1, 1941.—In order to determine the dependence of the probability of decay on momentum, mesotrons with range between 196 and 311 g./cm.^{2} of lead and with larger range were investigated separately. The softer group of mesotrons was found to disintegrate at a rate about 3 times faster than the more penetrating group, in agreement with the theoretical predictions based on the relativity change in rate of a moving clock. A new value of the proper lifetime of mesotrons of (2·4 ± 0·3) × 10^{-6} sec. is determined, based upon measurements with particles with momentum of approximately 5 × 10^{8} eV/c. AUTHORS.

884. Application of a pressure electrostatic generator to the transmutation of light elements by protons. T. LAURITSEN, C. C. LAURITSEN AND W. A. FOWLER. *Phys. Rev.*, **59**, *pp.* 241–252, *Feb.* 1, 1941.—The design and performance of a pressure electrostatic generator capable of operating at 1·7 MV in a cylindrical tank of overall length 13 ft. 6 in. and dia. 8 ft. at a pressure of 80 lb./in.^{2} are discussed. Studies of the γ-radiation produced in the transmutation of F^{19}, N^{15} and C^{13} protons are also reported. AUTHORS.

***885. Experiments with a slow neutron velocity spectrometer.** C. P. BAKER AND R. F. BACHER. *Phys. Rev.*, **59**, *pp.* 332–348, *Feb.* 15, 1941.—Neutron bursts were produced by modulation of the arc source of a small cyclotron. Neutrons subsequently slowed down in paraffin were detected by a BF$_{3}$ ionization chamber and linear amplifier.

Modulation of an additional amplifier allowed the counting of all detected neutrons as well as those arriving in a specified time interval. The absorption of thin Cd shows a resolved resonance absorption with maximum at 0·14 eV. The absorption edge of the thick Cd is not sharp, the transmission being 0·5 at 0·47 eV. Experiments with thick absorbers of Rh and In showed definite evidence of resonance absorption at 1·0 eV for both elements. The delayed emission of thermal neutrons from the paraffin surrounding the source was studied experimentally.
AUTHORS.

∗886. Report on experimental work on the development of the electron microscope. L. C. MARTIN, D. H. PARNUM AND G. S. SPEAK. *J. Roy. Micr. Soc.*, **59**, *pp.* 203–216, 1939.—An electron microscope is described which works with a cold-cathode discharge tube of about 56 kV, using a current which is stabilized by a saturated diode in series. Methods for testing the stability of pressure and voltage and for centring the optical system are described. The magnification is about 2000. Photographs were taken with a thin gold film containing holes as test object. It was found that satisfactory resolution (0·1 μ) could only be obtained in a small part of the field of view even after a drift of the image had been eliminated by using a shutter. The causes of the residual defects are discussed. R. P.

887. Optics of the electron microscope. L. C. MARTIN. *J. Roy. Micr. Soc.*, **59**, *pp.* 217–231, 1939.—The faults of optical systems for electrons are discussed by the methods usually applied to ordinary optics. The faults include chromatic aberration (axial and extra-axial), monochromatic aberrations, which are peculiar to magnetic lenses and cause axially symmetrical anisotropy, and spherical aberration. Methods of adjusting the optical system and the influence of certain unavoidable faults are discussed. R. P.

888. Images of minute particles, especially of molecules, by means of the universal electron microscope. M. v. ARDENNE. *Z. phys. Chem. A*, **187**, *pp.* 1–12, *July*, 1940. *In German.*—The limits to the discernability of minute particles are set partly by the resolving power of the microscope and partly by the contrast relations between object and carrier. With present methods metal particles with diameters as small as 10–15 Å are still perceptible. Spherical particles of organic substances must have diameters of at least 40 Å, otherwise they become indistinguishable due to the necessity of using a carrying foil for the objects. The electron-optical conditions relating to these contrast relations are dealt with in detail. Under favourable conditions it is possible to estimate the mol. wt. of certain substances. The values thus found are in fair agreement with values found by other methods. Electron images are given of bentonite sheets, metal particles, haemocyanin, edestin and glycogen molecules. [See Abstr. 2257 (1940).] R. N.

889. Photo-disintegration of the deuteron. W. RARITA, J. SCHWINGER AND H. A. NYE. *Phys. Rev.*, **59**, *pp.* 209–211, *Jan.* 15, 1941.—The photoelectric cross-section for Li γ-rays calculated by Fröhlich, Heitler and Kahn, from the formula of Bethe and Peierls (17·5 eMV) is questionable as the calculation was not carried out consistently. The problem is attacked by using simplified potentials which allow an exact solution for the pertinent states of the deuteron. Rough measurements of the total photo-electric cross-section do not give significant evidence concerning the tensor interaction. More valuable information can be obtained from the angular distribution of the disintegration particles than from attempting accurate measurements of the total cross-section. There should be a correlation between the angular distribution of photo-particles and both the total cross-section and angular distribution of fast neutrons scattered by protons. A. J. M.

See also Abstract 708.

MAGNETISM AND ELECTROMAGNETISM.

890. Ferromagnetic anisotropy and the itinerant electron model. H. BROOKS. *Phys. Rev.*, **58**, *pp.* 909–918, *Nov.* 15, 1940.—The approach used is that of the Bloch approximation of tight binding in the theory of metals, the exchange energy being treated as a Weiss internal field and the spin-orbit coupling being introduced as a perturbation. The anisotropy is shown to appear in the 4th approximation and to have the correct order of magnitude for Fe and Ni. The model also predicts the correct sign of K_1. AUTHOR.

891. Magnetization near saturation in polycrystalline ferromagnets. T. HOLSTEIN AND H. PRIMAKOFF. *Phys. Rev.*, **59**, *pp.* 388–394, *Feb.* 15, 1941.—An important mechanism involved in the variation of the magnetization of ferromagnets near saturation is the rotation of the magnetization vector under the combined influence of the magnetic field and crystalline anisotropy torques. The effect of this mechanism in polycrystalline specimens has been calculated by Akulov and Gans; their derivation, however, is subject to a serious error; namely, neglect of the internal magnetic field arising from the magnetization itself. In the present paper this internal field is taken into account; and a modified formula is derived on the dual assumption of randomness of orientation of crystallographic axes and irregularity of shapes of the individual crystal grains. Applications of the last formula to the analysis of the experimental data are discussed. AUTHORS.

892. Diamagnetism of phosphorus. S. R. RAO AND S. ARAVAMUDACHARI. *Proc. Indian Acad. Sci. A*, **12**, *pp.* 361–366, *Oct.*, 1940.—The magnetic susceptibility of solutions of white P in CS_2 has been examined at concentrations below 25% by weight. The sp. susceptibilities of pure P and CS_2 have also been determined. P solutions were studied by the Gouy method. The diamagnetic susceptibility of white P dissolved in CS_2 is larger than the value calculated from the additive law. The change of susceptibility for 100 g. of P is fairly constant in the range of concentrations studied. This increase may be due to the white P in the solid state containing higher complexes than P_4. When the solid is dissolved in CS_2, these higher complexes may break down to P_4 and bring about an increase of susceptibility. A second possibility is that the tetrahedral molecule of P in the solid state is not completely non-polar. The interactions between the molecules of P would disappear on dissolving the solid, giving rise to an increase of diamagnetic susceptibility. Raman effect data point out definitely that the latter alternative is more probable. AUTHORS.

893. Diamagnetic anisotropy and electronic structure of aromatic molecules. H. BROOKS. *J. Chem. Phys.*, **8**, *pp.* 939–949, *Dec.*, 1940.—Previous theories of the diamagnetic anisotropy of aromatic molecules, based on the method of molecular orbitals, neglect the correlation effects between electrons. In the present theory the anisotropy is treated from the standpoint of the Heitler-London-Pauling-Slater approximation by the inclusion of ionic terms in the secular equation. By means of an approximate treatment it is shown that correlation effects tend to reduce the diamagnetic susceptibility, the effect being relatively greater in complex molecules than in benzene. The contribution of higher-order permutation integrals is also discussed and found to be negligible. The variation of the anisotropy of benzene through all intermediate stages of approximation is discussed by means of a more exact model. All calculations were carried out by treating the permutational degeneracy by means of the Dirac vector model. AUTHOR.

894. Mutual inductance of 2 helices whose axes are parallel. C. SNOW. *Bur. Stand. J. Res. Wash.*, **25**, *pp.* 619–671, *Dec.*, 1940.—[Abstr. 161B (1941).]

*** 895. High rotational speeds in vacuum.** C. S. SMITH. *Rev. Sci. Instrum.*, **12**, *pp.* 15–20, *Jan.*, 1941.—[Abstr. 372B (1941)].

MEDICAL RADIOLOGY AND ELECTROLOGY.

896. Medical uses of radium. *Brit. J. Radiol.*, **14**, *pp.* 1–10, *Jan.*, 1941.—This paper is a summary of reports from various research centres for the year 1939. G. G.

OSCILLATIONS AND WAVES.

897. Longitudinal electromagnetic waves between parallel plates. V. C. A. FERRARO AND H. T. FLINT. *Proc. Phys. Soc., Lond.*, **53**, *pp.* 170–181, *March*, 1941. [Abstr. 460B (1941).]

898. Ultra-high-frequency oscillations generated by means of a demountable thermionic tube having electrodes of plane form. W. A. LEYSHON. *Proc. Phys. Soc., Lond.*, **53**, *pp.* 141–156, *March*, 1941. [Abstr. 465B (1941).]

PHOTO-ELECTRICITY.

899. Photoconductivity of a natural willemite crystal. R. C. HERMAN AND R. HOFSTADTER. *Phys. Rev.*, **59**, *pp.* 79–84, *Jan.* 1, 1941.—This paper deals with the dependence of the photoconductivity of a natural single crystal of willemite on the wavelength of exciting light, temperature and time. The ultra-violet absorption spectrum of this crystal has been obtained. AUTHORS.

900. Photo-ionization of molecules. B. D. NAG-CHOWDHURI AND K. BASU. *Proc. Nat. Inst. Sci. India*, **6**, 1, *pp.* 87–115, 1940.—Calculations are made of the probability of ionization of H_2 molecules by radiation. This molecule is chosen because the calculations are simpler than for others, but there are no experimental data with which the results could be compared. R. P.

THERMIONICS.

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